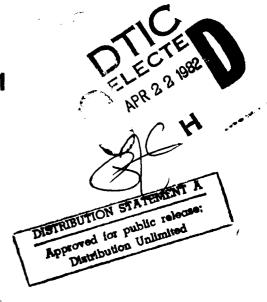




1980 CRC OCTANE NUMBER REQUIREMENT SURVEY

January 1981



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COORDINATING RESEARCH COUNCIL, INC. 219 PERIMETER CENTER PARKWAY, ATLANTA, GEORGIA 30346

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COORDINATING RESEARCH COUNCIL

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219 PERIMETER CENTER PARKWAY ATLANTA. GEORGIA 30346 (404) 396-3400

1980 CRC OCTANE NUMBER REQUIREMENT SURVEY (CRC Project No. CM-123-80)

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Prepared by the

1980 Analysis Panel

of the

CRC-Motor Octane Number Requirement Survey Group

January 1981

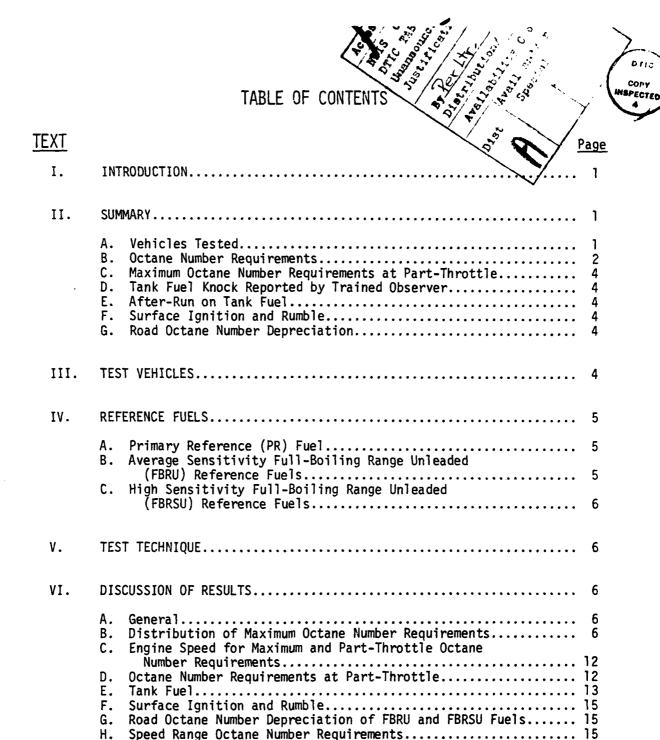
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I. INTRODUCTION

In the 24th annual statistical survey of current model vehicles conducted by the Coordinating Research Council, Inc., test data were obtained on 429 1980 model vehicles including 6 select models of special interest. Maximum octane number requirements under full- and part-throttle operating conditions were determined, and surface ignition knock and rumble, if present, were also reported.

Passenger cars and light-duty trucks including non-commercial vans (1/2 - 3/4 ton without four-wheel drive) were tested according to a weighted distribution. This year's survey includes analyses for the following vehicle categories:

- (1) U.S. and Imported Vehicles -- 429 vehicles
- (2) U.S. and Imported Cars -- 407 cars ·
- (3) U.S. Vehicles -- 344 vehicles
- (4) U.S. Cars -- 326 cars
- (5) Imported Vehicles -- 85 vehicles.

It should be noted that the term "cars" designates passenger cars only, while the term "vehicles" includes passenger cars plus vans and light-duty trucks.

The order of testing reference fuels was the same as the 1979 Survey, which is as follows:

Tank Fuel 1st High Sensitivity Full-Boiling Range Unleaded (FBRSU) Fuels 2nd Average Sensitivity Full-Boiling Range Unleaded (FBRU) Fuels 3rd Primary Reference (PR) Fuels 2 4th

Seventeen laboratories participated in this survey and submitted data on U.S. vehicles; fourteen of these labs also reported data on imported models. Participating laboratories are listed in Appendix A. Members of the CRC-Analysis Panel are identified in Appendix B.

II. SUMMARY

A. Vehicles Tested

Data were collected on 441 1980 model vehicles; however, analysis in this report was based on 429 vehicles. Data for 12 vehicles were excluded because of low odometer mileage. The 429 vehicles included 344 U.S. vehicles

and 85 imported vehicles. There were 326 U.S. passenger cars and 81 imported cars. There were 18 U.S. and 4 imported light-duty trucks and vans. The 1980 Survey included 388 vehicles tested in proportion to estimated production volume, plus 41 additional cars tested to provide larger samples of select models. The vehicles used in this program had an average of 11,253 deposit miles. The production-weighted engine displacement and compression ratio were 3.23 L and 8.40, respectively.

B. Octane Number Requirements

Requirements are expressed as the Research octane number (RON), Motor octane number (MON), and (R+M)/2 octane number of the reference fuel which produced the least audible knock due to either spark or surface ignition, whichever was limiting. Estimated octane number requirements for the U.S. vehicles are weighted in proportion to the 1980 vehicle model production figures and, for the imported models, in proportion to import sales volume in the U.S.

Maximum and part-throttle octane number requirements at the 50% and 90% satisfaction levels for the sample of 1980 U.S. and Imported Vehicles, U.S. and Imported Cars, U.S. Vehicles, U.S. Cars, and Imported Vehicles are given in Table I. A summary of the Research and Motor octane number requirements for FBRU fuels only is shown below:

FBRU Octane Number Requirements

1980 and Changes From 1979

	Octar	earch le No.	Motor Octane No.		
WEIGHTED POPULATION	50%	90%	50%	90%	
	<u>Sat.</u>	<u>Sat.</u>	<u>Sat.</u>	<u>Sat.</u>	
Maximum Octane Number Requi	rements	<u>i</u>			
All U.S. and Imported Vehicles	90.8	95.1	83.5	86.2	
^ from 1979*	-0.9	-1.9	0.9	-0.2	
All U.S. and Imported Cars	90.6	95.1	83.4	86.2	
^Δ from 1979*	-1.1	-1.8	0.8	-0.2	
All U.S. Vehicles	91.4	95.5	83.8	86.4	
Δ from 1979*	-0.9	-1.9	0.8	-0.3	
All U.S. Cars		95.5	83.8	86.4	
Δ from 1979*		-1.9	0.7	-0.3	
Imported Vehicles	89.0	92.6	82.3	84.6	
Δ from 1979*	0.1	-1.3	1.2	0.5	

^{*} The 1980 FBRU fuels over the RON range were 0.3 to 1.4 units lower in sensitivity than the 1979 FBRU fuels.

FBRU Octane Number Requirements

1980 and Changes From 1979 (Continued)

	Research Octane No.		Motor Octane No.	
WEIGHTED POPULATION	50%	90%	50%	90%
	Sat.	<u>Sat.</u>	Sat.	Sat.
Part-Throttle Octane Number Rec	uiremer	nts		
All U.S. and Imported Vehicles Δ from 1979*	86.4	93.1	80.6	84.9
	-1.8	-1.3	-0.2	+0.5
U.S. and Imported Cars Δ from 1979*	86.4 -1.5	92.8 -0.9	80.6	84.7 +0.7
U.S. Vehicles	86.5		80.7	85.3
^Δ from 1979*	-2.3		-0.3	+0.8
U.S. Cars	86.5	93.5	80.7	85.1
Δ from 1979*	-2.1	-0.7	-0.3	+0.8
Imported Vehicles	85.7	91.6	80.2	83.9
△ from 1979*	+3.5	-2.3	+3.0	- 0.2

Maximum octane requirements for the select models at the 50% and 90% satisfaction levels for PR, FBRU, and FBRSU fuels are shown in Table II, and summarized below for FBRU fuels only.

Select Models

Maximum FBRU Octane Number Requirements

		Resea Octai	arch ne No.	Motor Octane No.	
Select Model	No. Tested	50% Sat.	90% Sat.	50% Sat.	90% Sat.
NC5 225/HC5 225					
IC5 225/LC5 225 NC7 228/HC7 228	24	91.1	95.9	83.6	86.7
IC7 228/LC7 228	21	86.2	90.5	80.4	83.3
NIJ 244	12	92.1	94.1	84.3	85.5
OCA 242/MCA 242	14	91.9	93.9	84.1	85.4
0 V250/M V250	14	92.3	95.4	84.4	86.3
PC 137/KC 137/DC 137	15	93.8	98.2	85.4	88.3

^{*} See footnote, page 2.

C. Maximum Octane Number Requirements at Part-Throttle

Incidence of part-throttle knock with FBRU being equal to or greater than full-throttle knock was about the same in 1980 as it was in 1979. Maximum requirements occurred at part-throttle in 14.5% of all 1980 model vehicles with FBRU fuels, compared with 15.9% in 1979.

D. Tank Fuel Knock Reported by Trained Observer

In the 1980 Survey, 49.9% of the weighted vehicle population was found to knock on tank fuel, compared with 47% in the 1979 Survey. Note that these values reflect a combination of both vehicle octane requirements and the customer's choice of octane quality of the gasoline used in the vehicle.

E. After-Run on Tank Fuel

Out of 404 vehicles tested by trained observers, there were 10 reported incidents of after-run on tank fuel. Note that trained observers' reports are based on a single data point made on the fuel in the test vehicle tank with spark timing at manufacturer's recommended setting. Owners reported a higher percentage of after-run (11.5% vs 2.5%).

F. Surface Ignition and Rumble

There was one car in the 1980 Survey reported with both surface ignition and spark knock; none had rumble.

G. Road Octane Number Depreciation

Road octane number depreciation of FBRU fuels in the range 86 to 100 RON varied from 1.4 to 4.2, compared with 1.2 to 5.5 in the 1979 Survey. Depreciation of FBRSU fuels in the range of 87 to 101 RON varied from 2.7 to 4.9, compared with 2.2 to 6.0 last year.

III. TEST VEHICLES

A total of 429 1980 model vehicles was tested in this year's survey. Non-commercial vans and light-duty trucks (1/2 - 3/4 ton without four-wheel drive) were included as part of the total vehicle population. Of the 429 vehicles tested, there were 326 U.S. and 81 imported cars plus 18 U.S. and 4 imported vans and light-duty trucks. There are an additional 12 vehicles with less than 4000 odometer miles which were not included in the analyses; however, the test data for these cars are listed in Appendix E with observation numbers 800 to 811.

To provide a statistical sample of vehicles on the road, 388 vehicles were tested in proportion to their percentage of total vehicle production, and 41 additional cars were tested to provide a larger sample of each of 6 select models of special interest, all of which had automatic transmissions. Specifications for the select models are shown in Table III.

In the 1980 Survey, 77% of the vehicles were equipped with automatic transmissions, and 70% were equipped with air conditioners. The vehicles used in this program had an average of 11,253 deposit miles. Table IV shows the distribution of odometer mileage for vehicles tested in both the 1980 and 1979 Surveys. The 1980 distribution is also snown as a barchart in Figure 1. The weighted engine displacement for the 1980 fleet was 3.23 L; the weighted compression ratio was 8.40.

Participants were assigned specific vehicle models in a pattern which minimized data bias due to differences in testing and vehicle sampling. The United States was divided into four geographical areas, and assignments for vehicles of a given model were divided among laboratories within each geographical area. The basic timing was adjusted to the manufacturers' recommended setting prior to test. A total of 100 vehicles was adjusted. Thirty-five vehicles were more than $\pm 2^\circ$ from the manufacturer's specification when received, compared with 67 in the 1979 Survey. Number of vehicles and the degrees advanced or retarded are shown in Table V.

IV. REFERENCE FUELS

Average laboratory octane number ratings and blending data for the FBRU and FBRSU fuels are shown in Tables D-I and D-II of Appendix D. Sensitivities of the 1980 full-boiling range reference fuels are summarized in Table D-III, and a comparison of sensitivities of 1980 and 1979 fuels is shown in Table D-IV. The 1980 FBRU fuels over the RON range were 0.3 to 1.4 octane numbers lower in sensitivity and were 6.3% to 24.8% lower in aromatic content than the 1979 fuels. The FBRSU fuels were 0.8 higher to 0.4 lower in sensitivity. Inspection data furnished by the fuel supplier are shown in Table D-V.

A. Primary Reference (PR) Fuel

Isooctane and normal heptane, meeting ASTM specifications, were blended in two octane number increments from 76 to 82 RON, and in one octane number increments from 82 to 100 RON.

B. Average Sensitivity Full-Boiling Range Unleaded (FBRU) Reference Fuels

FBRU fuels were prepared from three base blends (RMFD-326-80, RMFD-327-80, and RMFD-328-80) in two octane number increments from 78 to 84 RON, and in one octane number increments from 84 to 101 RON.

C. <u>High Sensitivity Full-Boiling Range</u> Unleaded (FBRSU) Reference Fuels

FBRSU fuels were prepared from three base blends (RMFD-329-80, RMFD-330-80, and RMFD-331-80) in two octane number increments from 78 to 84 RON, and in one octane number increments from 84 to 101 RON.

V. TEST TECHNIQUE

The test technique (CRC Designation E-15-80) specified that octane number requirements be determined at level road acceleration conditions. The order of fuel testing was Tank Fuel, FBRSU, FBRU, and PR fuels. Knocking tendency was investigated at both maximum throttle and part-throttle to determine the most cricital condition. The occurrence of other abnormal combustion noise, such as surface ignition knock and rumble, was also reported.

The octane number requirement of a vehicle is defined as the Research or Motor octane number of the highest octane test fuel which produces borderline knock due either to spark or surface ignition, whichever is limiting. The maximum octane number requirement of the vehicle is defined as the highest of these requirements, whether at full- or part-throttle. Maximum octane number requirements were obtained over the speed range with PR fuel only. In addition, maximum part-throttle requirements were determined with FBRU fuels down to the limit of the lowest available fuel.

VI. DISCUSSION OF RESULTS

A. General

Of the 17 participating laboratories, 3 used level roads, 13 used chassis dynamometers, and 1 used both. Weather conditions under which tests were conducted varied considerably among participants. On the average, the barometer was 29.71 in. Hg., ambient temperature was 74°F , and humidity was 70 gr/lb. Test conditions for individual observations are reported in Appendix E.

B. Distribution of Maximum Octane Number Requirements

The octane number requirement data were used to prepare satisfaction curves for the following samples of 1980 model vehicles: (1) U.S. and Imported Vehicles; (2) U.S. and Imported Cars; (3) U.S. Vehicles; (4) U.S. Cars; and (5) Imported Vehicles.

In preparing these curves, the percentages of vehicles satisfied were weighted in accordance with final 1980 U.S. model-year production data and with U.S. sales figures in the case of imports. Each curve should, therefore, provide an estimate of the distribution of octane number. requirements of the appropriate vehicle population on the road. The procedure for assigning weighting factors is described in Appendix I.

1. U.S. and Imported Vehicles

In the 1980 Survey, maximum octane number requirements were determined on 429 U.S. and imported vehicles with PR, FBRU, and FBRSU fuels.

Maximum Research octane number requirements for all three reference fuel series are shown in Figures 2a (rectangular coordinates) and 2b (probability plot). Maximum Research, Motor, and (R+M)/2 octane number requirements are listed in Table VI. The 50% and 90% satisfaction level requirements are as follows:

	Maximum Octane Number Requirements							
	50% Satisfied				90% Satisfied			
<u>Fuel</u>	RON	MON	(R+M)/2		RON	MON	(R+M)/2	
PR FBRU FBRSU	89.4 90.8 92.7	89.4 83.5 82.2	89.4 87.2 87.5		92.8 95.1 97.7	92.8 86.2 85.2	92.8 90.6 91.4	

Comparisons of 1980 and 1979 Survey maximum Research, Motor, and (R+M)/2 octane number requirements are shown in Tables VII, VIII, and IX, respectively, for the three fuel series. Distributions of maximum RON requirements are shown in Figure 3 for PR fuel, Figure 4 for FBRU fuels, and Figure 5 for FBRSU fuels. The differences at the 50% and 90% satisfaction levels are summarized below:

Differences Between 1980 and 1979 Maximum Octane Number Requirements

Fue1	50	% Satis	fied	90% Satisfied		
	RON	MON	(R+M)/2	RON	MON	(R+M)/2
PR FBRU FBRSU	0.1 -0.9 0.3	0.1 0.9 0.2	0.1 0.0 0.3	-0.2 -1.9 -0.1	-0.2 -0.2 -0.8	-0.2 -1.1 -0.5

Confidence limits for maximum octane number requirement distributions of 1980 U.S. and imported vehicles are given in Appendix G, Table G-1. The 95% confidence limits for Research octane requirements were from ± 0.25 to ± 0.37 at the 50% satisfaction level and from ± 0.34 to ± 0.50 at the 90% satisfaction level.

2. U.S. and Imported Cars

Maximum octane number requirements were determined on 407 U.S. and imported cars with PR, FBRU, and FBRSU fuels.

Maximum Research, Motor, and (R+M)/2 octane number requirements on all three fuel series are given in Table X. Maximum octane number requirements at the 50% and 90% satisfaction levels are summarized below:

	Maximum Octane Number Requirements						
	50	50% Satisfied			90% Satisfied		
<u>Fue1</u>	RON	MON	(R+M)/2	RON	MON	(R+M)/2	
PR FBRU FBRSU	89.2 90.6 92.4	89.2 83.4 82.0	89.2 87.0 87.2	92.7 95.1 97.5	92.7 86.2 85.0	92.7 90.6 91.3	

The maximum Research octane number requirements for 1980 U.S. and imported cars are compared with 1979 model-year data in Table XI for PR, FBRU, and FBRSU fuels; corresponding comparisons of Motor and (R+M)/2 octane number requirements are given in Tables XII and XIII, respectively. Differences between 1980 and 1979 data at the 50% and 90% satisfaction levels are as follows:

<u>Octane Number Requirements</u>

<u>Fuel</u>	50	% Satis	fied	90% Satisfied		
	RON	MON	(R+M)/2	RON	MON	(R+M)/2
PR FBRU FBRSU	0.0 -1.1 - 0.2	0.0 0.8 -0.2	0.0 -0.2 -0.2	-0.5 -1.8 -0.2	-0.5 -0.2 -0.9	-0.5 -1.0 -0.5

Confidence limits for maximum octane number requirement distributions of 1980 U.S. and imported cars are given in Appendix G, Table G-I. The 95% confidence limits for Research octane requirements were from ± 0.25 to ± 0.40 at the 50% satisfaction level and from ± 0.34 to ± 0.54 at the 90% satisfaction level.

3. U.S. Vehicles

Maximum octane number requirements were determined on 344 U.S. vehicles with PR, FBRU, and FBRSU fuels.

Distributions of maximum Research octane number requirements are plotted in Figures 6a and 6b for the three fuel series. Research, Motor, and (R+M)/2 octane number requirements for the U.S. vehicles are given in Table XIV. Octane number requirements at the 50% and 90% satisfaction levels are listed below:

<u> Maximum Octane Number Requirements</u>							
	50% Satisfied			909	90% Satisfied		
<u>Fuel</u>	RON	MON	(R+M)/2	RON	MON	(R+M)/2	
PR FBRU FBRSU	89.8 91.4 93.4	89.8 83.8 82.6	89.8 87.6 88.0	93.0 95.5 98.1	93.0 86.4 85.5	93.0 90.9 91.8	

A comparison of octane number requirements of 1980 and 1979 U.S. vehicles for the three fuel series is shown in Tables XV, XVI, and XVII in terms of RON, MON, and (R+M)/2, respectively. Distributions of maximum Research octane number requirements are shown in Figure 7 for PR fuel, in Figure 8 for FBRU fuels, and in Figure 9 for FBRSU fuels. Differences between octane number requirements of 1980 and 1979 U.S. vehicles at the 50% and 90% satisfaction levels are given in the following table:

<u>Differences Between 1980 and 1979 Maximum</u> Octane Number Requirements

	50	% Satis	fied	90	% Satis	fied
<u>Fuel</u>	RON	MON	(R+M)/2	RON	MON	(R+M)/2
PR FBRU FBRSU	0.3 -0.9 0.2	0.3 0.8 0.1	0.3 0.0 0.2	-0.3 -1.9 0.0	-0.3 -0.3 -0.7	-0.3 -1.1 -0.4

Confidence limits for maximum octane number requirement distributions of 1980 U.S. vehicles are listed in Appendix G, Table G-I. The 95% confidence limits for Research octane requirements were from ± 0.26 to ± 0.39 at the 50% satisfaction level and from ± 0.36 ± 0.53 at the 90% satisfaction level.

4. U.S. Cars

Maximum octane number requirements were determined on 326 U.S. cars with PR, FBRU, and FBRSU fuels.

Maximum Research, Motor, and (R+M)/2 octane number requirements for all three fuel series are listed in Table XVIII, and summarized below at the 50% and 90% satisfaction levels:

		Maximur	<u>n Octane Nu</u>	mber Requi	rements	
	50	% Satis	fied	909	& Satist	fied
<u>Fuel</u>	RON	MON	(R+M)/2	RON	MON	(R+M)/2
PR FBRU FBRSU	89.6 91.3 93.1	89.6 83.8 82.5	89.6 87.5 87.8	93.0 95.5 97.9	93.0 86.4 85.4	93.0 90.9 91.6

The maximum Research, Motor, and (R+M)/2 octane number requirements of U.S. cars in the 1980 and 1979 Surveys are compared in Tables XIX, XX, and XXI, respectively, for all three fuel series. The differences at the 50% and 90% satisfaction levels are as follows:

<u>Octane Number Requirements</u>

	50	% Satis	fied	90	% Satist	fied
<u>Fue1</u>	RON	MON	(R+M)/2	RON	MON	(R+M)/2
PR	-0.1	-0.1	-0.1	-0.5	-0.5	-0.5
FBRU	-1.2	0.7	-0.3	-1.9	-0.3	-1.1
FBRSU	-0.4	-0.2	-0.2	-0.4	-1.0	-0.8

Confidence limits for maximum octane number requirement distributions of 1980 U.S. cars are given in Appendix G, Table G-I. The 95% confidence limits for Research octane requirements were from ± 0.28 to ± 0.41 at the 50% satisfaction level and from ± 0.37 to ± 0.56 at the 90% satisfaction level.

5. Imported Vehicles

Maximum octane number requirements were determined on 85 imported vehicles with PR, FBRU, and FBRSU fuels.

Maximum Research octane number requirements for all three reference fuel series are shown in Figures 10a and 10b. Maximum octane number requirements for RON, MON, and (R+M)/2 are listed in Table XXII. The 50% and 90% satisfaction level maximum octane requirements are listed below:

		Maximu	um Octane	<u>Number Requ</u>	irements	<u> </u>
	5	0% Sati	sfied	90	% Satis	fied
<u>Fuel</u>	RON	MON	(R+M)/2	RON	MON	(R+M)/2
PR FBRU FBRSU	88.0 89.0 90.8	88.0 82.3 81.1	88.0 85.6 86.0	91.5 92.6 95.0	91.5 84.6 83.5	91.5 88.6 89.2

The maximum Research, Motor, and (R+M)/2 octane number requirements of imported vehicles in the 1980 and 1979 Surveys are compared in Tables XXIII, XXIV, and XXV, respectively, for all three fuel series. The differences at the 50% and 90% satisfaction levels are as follows:

<u>Octane Number Requirements</u>

	50	% Satis	fied	90	90% Satisfied			
<u>Fuel</u>	RON	MON	(R+M)/2	RON	MON	(R+M)/2		
PR	0.5	0.5	0.5	0.0	0.0	0.0		
FBRU	0.1	1.2	0.6	-1.3	0.5	-0.4		
FBRSU	1.5	1.0	1.3	0.1	-0.2	-0.1		

Confidence limits for maximum octane number requirement distributions of 1980 imported vehicles are given in Appendix G, Table G-I. The 95% confidence limits for Research octane requirements were from ± 0.61 to ± 0.72 at the 50% satisfaction level and from ± 0.83 to $\pm .97$ at the 90% satisfaction level.

6. Select Models

The select model group consisted of a total of six engine-chassis combinations. Five of these were the select models from the program scheduled to be tested. One other model (NIJ 244) had a sufficient number tested in the statistical sample and was included as a select model. The identification and specifications of the engine-chassis combinations are given in Table III.

Maximum Research and Motor octane number requirements for select models are shown for 50% and 90% satisfaction levels on PR, FBRU, and FBRSU fuels in Table II. Maximum octane number requirements for each select model at various satisfaction levels are listed in Appendix H, Table H-I. Maximum Research, Motor, and (R+M)/2 octane number requirements for the individual cars of each select model are given in Table H-II.

Maximum Research octane number satisfaction curves for the six select models are shown in Figures 11 through 16 for all three fuel series. The individual data points plotted on the figures represent the maximum requirements obtained on FBRU reference fuel. Each curve was constructed by use of the "Z" method, which is discussed in Appendix I. The 95% confidence limits for maximum requirements are given in Appendix G, Table G-III.

C. Engine Speed for Maximum and Part-Throttle Octane Number Requirements

Engine speeds where maximum octane number requirements occurred for each select model are shown in Table XXVI for PR, FBRU, and FBRSU fuels. Weighted data for all 1980 U.S. and imported vehicles are shown in Table XXVII and Figure 17 for both maximum and part-throttle octane number requirements. Vehicles tended to knock at higher speeds as the sensitivity of the reference fuel increased. Part-throttle octane requirements occurred at somewhat lower speeds than the maximum throttle requirements.

D. Octane Number Requirements at Part-Throttle

1. <u>Maximum Octane Number Requirements</u> at Part-Throttle

The throttle positions for maximum octane number requirements of tested vehicles were reported as full-throttle and/or part-throttle. The number and percentage of vehicles having FBRU part-throttle octane number requirements equal to or greater than full-throttle requirements are shown in Table XXVIII. The 1979 Survey data are shown for comparison. The percentages of all vehicles having maximum requirements at part-throttle were 15.9% for 1980, compared with 14.6% for 1979.

2. <u>Part-Throttle Octane Number Requirement</u> <u>Distributions on FBRU Fuels</u>

Part-throttle octane number requirements were determined on FBRU fuels at the critical manifold vacuum as defined in the CRC Test Procedure (Appendix C, Attachment 1). Weighted population distributions were developed from these data for the five vehicle categories: (1) U.S. and Imported Vehicles (389 vehicles); (2) U.S.

and Imported Cars (375 cars); (3) U.S. Vehicles (312 vehicles); (4) U.S. Cars (296 cars); (5) Imported Vehicles (77 vehicles). Part-throttle Research, Motor, and (R+M)/2 octane number requirements for each respective category are summarized in Tables XXIX, XXX, XXXI, XXXII, and XXXIII. Distribution of part-throttle Research octane number requirements are presented in Figures 18a and 18b for U.S. and imported vehicles, Figures 19a and 19b for U.S. vehicles, and Figures 20a and 20b for imported vehicles.

Maximum FBRU Research octane number requirements are compared with part-throttle requirements for U.S. and imported vehicles in Table XXXIV and Figure 21. The difference between maximum and part-throttle Research octane number requirements decreased with increasing octane number.

Part-throttle FBRU Research and Motor octane number requirements for the 1980 and 1979 Surveys are compared in Table XXXV for U.S. and imported vehicles, as well as U.S. vehicles only. Distributions of the part-throttle FBRU Research octane number requirements of the 1980 and 1979 U.S. and imported vehicles are shown in Figure 22 and U.S. vehicles only in Figure 23. At the 50% satisfaction level, the requirements of the 1980 U.S. and imported vehicle sample were 1.8 RON and 0.2 MON lower than the 1979 sample; at the 90% satisfaction level, the 1980 models were 1.3 RON lower and 0.5 MON higher than the 1979 models. Requirements for the 1980 U.S. vehicles only were 2.3 RON and 0.3 MON lower than the 1979 U.S. vehicles at the 50% satisfaction level and 0.8 RON lower and 0.8 MON higher at the 90% satisfaction level.

Confidence limits for part-throttle Research and Motor octane number requirement distributions for all five categories of 1980 vehicles are shown in Appendix G, Table G-II. The 95% confidence limits at the 50% and 90% satisfaction levels ranged from ± 0.51 to ± 0.87 for RON and ± 0.33 to ± 0.55 for MON for all cases except imported vehicles, which have much wider confidence ranges.

E. Tank Fuel

As required by the program, tank fuel was tested for incidence of knock whenever an owner's questionnaire was obtained; however, owner's questionnaires were obtained only when the vehicle tested had a regular driver and the ignition timing did not have to be reset. To gain additional information, tank fuel ratings were made by many participants on many other vehicles which did not meet the restrictions listed.

1. Owner-Observer Comparison of Tank Fuel Knock

Owner questionnaires were completed for 218 vehicles which had spark timing set to manufacturers' specifications. Of these vehicles, 51.1% were reported by trained observers to be knocking on tank fuel. Of the same 218 vehicles, 31.2% were reported by the owner to be knocking on tank fuel. This results in an owner versus observer detected knock ratio of 0.61 for 1980. Owner-observer comparison of tank fuel knock data for 1980, along with previous survey data, is presented in Table XXXVI.

2. Objectionable vs. Unobjectionable Knock

Objectionable knock was reported by the owners in 33 of the 218 vehicles tested. Of those owners reporting knock, 48.5% found that knock to be objectionable. This percentage of objectionable knock is much lower than the 60.8% reported in the previous 1979 Survey, as shown in Table XXXVI.

3. Tank Fuel Knock Reported by Trained Observers

Tank fuel knock observations were reported on 374 of the 429 test vehicles. The percentages of all 1980 vehicles and the select models knocking on tank fuel are shown in Table XXXVII. On a weighted basis, 49.9% of the 1980 vehicles knocked on tank fuel compared with 47.3% of the vehicles in the 1979 Survey and 47.2% in the 1978 Survey. It should be noted that these values on percent of all vehicles knocking reflect not only the octane requirements of the vehicles tested, but also the choice of the octane quality of the gasoline purchased by the customer.

4. After-Run on Tank Fuel

After-run was reported by trained observers on 10 of 404 vehicles tested on tank fuel for after-run in 1980. Owner questionnaires were completed for 218 vehicles on after-run. Of these vehicles, there were 25 reports of after-run on tank fuel. The higher percentage of after-run reports from owners is credible, since the trained observers' reports are based on a single data point (one observation) made on the fuel in the test vehicle's tank at the time of the Survey, while owners' reports are based on multiple observations using fuels of various octane quality.

Maximum FBRU octane requirements and tank fuel octane numbers for the vehicles with after-run reported by the owners (spark advance at manufacturers' recommended setting) are shown in Table XXXVIII.

F. Surface Ignition and Rumble

There was 1 car in the 1980 Survey reported with both surface ignition and spark knock; none had rumble. In the 1979 Survey, there were 3 reports of surface ignition.

G. Road Octane Number Depreciation of FBRU and FBRSU Fuels

Road octane number ratings and road octane number depreciation for FBRU and FBRSU fuels were determined from the octane requirement data for all vehicles. The results are shown in Table XXXIX.

In this report, the road octane number rating of FBRU and FBRSU fuels is defined as the primary reference fuel octane level which satisfied the same percentage of vehicles. Depreciation values were established by subtracting the road octane number rating of the fuel from its Research octane number. Depreciation values of FBRU fuels in the range 86 to 100 RON varied from 1.4 to 4.2, compared with 1.2 to 5.5 in the 1979 Survey. Depreciation of FBRSU fuels in the range 87 to 101 RON varied from 2.7 to 4.9, compared with 2.2 to 6.0 in last year's survey.

H. Speed Range Octane Number Requirements

Primary reference fuel octane number requirements at various engine speeds were determined on 337 U.S. and imported vehicles. Results were analyzed on 6 select models. The data are presented in Appendix F.

I. Gear Position for Maximum Requirements

The transmission gear position where maximum octane number requirements were observed with FBRU fuels is shown in Table J-1 of Appendix J. Of the 429 vehicles tested, 66% of the automatic transmission cars had the maximum requirements in the highest gear and 30% in passing gear. Eighty-five percent of the manual transmission cars had maximum requirements in the highest gear and 8% in a lower gear. Overall, 69% had maximum requirements in the highest gear and 25% in passing or lower gear.

TABLES

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FIGURES

DCTANE NUMBER REQUIREMENTS WITH 95% CONFIDENCE LIMITS

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			3	Research (Research Octane No.	Motor Octane No.	ane No.
	Weighted Population	Fuel	Vehicles	50% Sat.	90% Sat.	50% Sat.	90% Sat.
A.	Maximum Octane Number Requirements						
	U.S. and Imported Vehicles	PR FBRU FBRSU	429 429 429	89.4 ±0.25 90.8 ±0.32 92.7 ±0.37	92.8 ±0.34 95.1 ±0.43 97.7 ±0.50	89.4 ±0.25 83.5 ±0.20 82.2 ±0.21	92.8 ±0.34 86.2 ±0.27 85.2 ±0.29
	U.S. and Imported Cars	PR FBRU FBRSU	407 407 407	89.2 ±0.25 90.6 ±0.35 92.4 ±0.40	92.7 ±0.34 95.1 ±0.47 97.5 ±0.54	89.2 ±0.25 83.4 ±0.22 82.0 ±0.23	92.7 ±0.34 86.2 ±0.29 85.0 ±0.31
	U.S. Vehicles	PR FBRU FBRSU	344 344 344	89.8 ±0.26 91.4 ±0.34 93.4 ±0.39	93.0 ±0.36 95.5 ±0.46 98.1 ±0.53	89.8 ±0.26 83.8 ±0.22 82.6 ±0.23	93.0 ±0.36 86.4 ±0.29 85.5 ±0.31
	U.S. Cars	PR FBRU FBRSU	326 326 326	89.6 ±0.28 91.3 ±0.37 93.1 ±0.41	93.0 ±0.37 95.5 ±0.50 97.9 ±0.56	89.6 ±0.28 83.8 ±0.23 82.5 ±0.24	93.0 ±0.37 86.4 ±0.31 85.4 ±0.32
	Imported Vehicles	PR FBRU FBRSU	85 85 85	88.0 ±0.61 89.0 ±0.65 90.8 ±0.72	91.5 ±0.83 92.6 ±0.88 95.0 ±0.97	88.0 ±0.61 82.3 ±0.41 81.1 ±0.42	91.5 ±0.83 84.6 ±0.56 83.5 ±0.57
æ.	Part-Throttle Octane Number Requirements						
	U.S. and Imported Vehicles	FBRU	389	86.4 ±0.53	93.1 ±0.72	80.6 ±0.34	84.9 ±0.46
	U.S. and Imported Cars	FBRU	375	86.4 ±0.51	92.8 ±0.69	80.6 ±0.33	84.7 ±0.44
	U.S. Vehicles	FBRU	312	86.5 ±0.65	93.7 ±0.87	80.7 ±0.41	85.3 ±0.55
	U.S. Cars	FBRU	296	86.5 ±0.61	93.5 ±0.82	80.7 ±0.39	85.1 ±0.52
	Imported Vehicles	FBRU	77	85.7 ±1.14	91.6 ±1.54	80.2 ±0.73	83.9 ±0.99

TABLE II

MAXIMUM OCTANE NUMBER REQUIREMENTS - 1980 SELECT MODELS

				earch ne No.	Moi Octar	tor ne No.
Car Model	No. Tested	PR	FBRU	FBRSU	FBRU	FBRSU
			50%	Satisfie	d	
NC5 225/HC5 225 IC5 225/LC5 225	24	88.6	91.1	93.7	83.6	82.8
NC7 228/HC7 228 IC7 228/LC7 228	21	84.6	86.2	87.2	80.4	79.0
NIJ 244	12	90.3	92.1	92.8	84.3	82.2
OCA 242/MCA 242	14	91.0	91.9	93.1	84.1	82.5
0 V250/M V250	14	91.4	92.3	93.0	84.4	82.4
PC 137/KC 137/DC 137	15	92.2	93.8	95.3	85.4	83.8
			90%	Satisfie	d	
NC5 225/HC5 225 IC5 225/LC5 225	24	92.3	95.9	98.6	86.7	85.8
NC7 228/HC7 228 IC7 228/LC7 228	21	88.3	90.5	91.6	83.3	81.7
NIJ 244	12	91.6	94.1	94.9	85.5	83.5
OCA 242/MCA 242	14	92.7	93.9	96.1	85.4	84.4
0 V250/M V250	14	93.6	95.4	95.7	86.3	83.9
PC 137/KC 137/DC 137	15	95.8	98.2	99.6	88.3	86.5

TABLE III

1980 SELECT MODEL SPECIFICATIONS

Model	Disp.	Engine Type	Brake Horse- Power	Carb. Bbl.	Comp. Ratio
Chevrolet: Malibu	4.4	V-8	120	2	8.3
Chrysler: Volare/Aspen/Le Baron	3.7	L-6	90	1	8.4
Ford Motor: Fairmont/Zephyr	4.2	V - 8	119	2	8.8
Ford Motor: LTD/Marquis	5.0	V - 8	130	2VV	8.4
General Motors: "X" Body	2.5	L-4	90	2	8.2
General Motors: "X" Body	2.8	V-6	115	2	8.5

TABLE IV

DISTRIBUTION OF ODOMETER MILEAGE FOR TESTED VEHICLES

		No. of Vehicles	Within Mileage Increments
		1980 Vehicles	1979 Vehicles
0 -	1,999	0	1
2,000 -	3,999	0	8
4,000 -	5,999	44	48
6,000 -	7,999	86	122
8,000 -	9,999	67	94
10,000 -	11,999	68	74
12,000 -	13,999	56	50
14,000 -	15,999	36	31
16,000 -	17,999	33	29
18,000 -	19,999	21	. 9
20,000 -	24,999	11	21
25,000 -	25,999	5	3
30,000 +		2	0
	No. of Vehicles	429	490
	Average Mileage	11,253	10,371

TABLE V

1980 BASIC TIMING ADJUSTMENTS

<u>Degrees</u>	No. <u>Vehi</u>	of cles
	+	-
1	12	10
2	28	15
3	6	4
4	7	7
5	2	2
6	2	· 2
7	0	0
8	0	0
9	0	0
10	0	0
11	1	2
		_
	58	42

Total 100

TABLE VI

MAXIMUM RESEARCH, MOTOR, AND (R+M)/2 OCTANE NUMBER REQUIREMENTS

1980 U.S. and Imported Vehicles

			BRU Fue	els	F	BRSU FL	uels
Percent Satisfied	PR <u>Fuels</u>	RON	MON	(R+M)/2	RON	MON	(R+M)/2
10	84.3	85.6	80.1	82.9	86.8	78.9	82.8
20	86.3	88.0	81.7	84.8	89.6	80.4	85.0
30	87.6	89.1	82.4	85.7	90.7	81.0	85.9
40	88.6	90.0	83.0	86.5	91.7	81.6	86.7
50	89.4	90.8	83.5	87.2	92.7	82.2	87.5
60	90.1	91.7	84.0	87.8	93.7	82.8	88.3
70	90.8	92.6	84.6	88.6	94.8	83.4	89.1
80	91.6	93.7	85.3	89.5	96.1	84.2	90.1
90	92.8	95.1	86.2	90.6	97.7	85.2	91.4
95	93.9	96.1	86.8	91.5	98.9	86.2	92.5
98	95.0	97.5	87.7	92.6	100.0	87.3	93.6
99	95.5	98.8	88.6	93.7	н	Н	н

TABLE VII

COMPARISON OF MAXIMUM RESEARCH OCTANE NUMBER REQUIREMENTS

1980 and 1979 U.S. and Imported Vehicles

Downent		PR Fuels	5	FI	BRU Fue	1s	F	BRSU Fue	1s
Percent <u>Satisfied</u>	1980	1979	Δ	1980	1979	Δ	1980	1979	Δ
10	84.3	84.8	-0.5	85.6	86.2	-0.6	86.8	86.9	-0.1
20	86.3	86.6	-0.3	88.0	88.6	-0.6	89.6	89.3	0.3
30	87.6	87.6	0.0	89.1	90.1	-1.0	90.7	90.6	0.1
40	88.6	88.5	0.1	90.0	91.0	-1.0	91.7	91.6	0.1
50	89.4	89.3	0.1	90.8	91.7	-0.9	92.7	92.4	0.3
60	90.1	90.1	0.0	91.7	92.6	-0.9	93.7	93.6	0.1
70	90.8	90.9	-0.1	92.6	93.8	-1.2	94.8	94.9	-0.1
80	91.6	91.7	-0.1	93.7	95.1	-1.4	93.1	96.0	0.1
90	92.8	93.0	-0.2	95.1	97.0	-1.9	97.7	97.8	-0.1
95	93.9	94.3	-0.4	96.1	99.5	-3.4	98.9	100.0	-1.1
98	95.0	96.0	-1.0	97.5	Н	•	100.0	Н	-
99	95.5	97.2	-1.7	98.8	Н	-	Н	н	-

TABLE VIII

COMPARISON OF MAXIMUM MOTOR OCTANE NUMBER REQUIREMENTS

1980 and 1979 U.S. and Imported Vehicles

D +	PR Fuels			F	BRU Fue	<u>ls</u>	FBRSU Fuels		
Percent <u>Satisfied</u>	1980	1979	Δ	1980	1979		1980	<u> 1979</u>	
10	84.3	84.8	-0.5	80.1	79.7	0.4	78.9	78.0	0.9
20	86.3	86.6	-0.3	81.7	81.0	0.7	80.4	80.2	0.2
30	87.6	87.6	0.0	82.4	81.8	0.6	81.0	80.9	0.1
40	88.6	88.5	0.1	83.0	82.2	0.8	81.6	81.5	0.1
50	89.4	89.3	0.1	83,5	82.6	0.9	82.2	82.0	0.2
60	90.1	90.1	0.0	84.0	83.2	0.8	82.8	82.7	0.1
70	90.8	90.9	-0.1	84.6	84.0	0.6	83.4	83.7	-0.3
80	91.6	91.7	-0.1	85.3	84.9	0.6	84.2	84.4	-0.2
90	92.8	93.0	-0.2	86.2	86.4	-0.2	85.2	86.0	-0.8
95	93.9	94.3	-0.4	86.8	88.4	-1.6	86.2	88.0	-1.8
98	95.0	96.0	-1.0	87.7	Н	-	87.3	н	-
99	95.5	97.2	-1.7	88.6	Н	-	Н	Н	-

TABLE IX

COMPARISON OF MAXIMUM (R+M)/2 OCTANE NUMBER REQUIREMENTS

1980 and 1979 U.S. and Imported Vehicles

		PR Fuels			FBRU Fuels			FBRSU Fuels		
Percent <u>Satisfied</u>	1980	1979	Δ	1980	1979	Δ	1980	1979	Δ	
10	84.3	84.8	-0.5	82.9	83.0	-0.1	82.8	82.4	0.4	
20	86.3	86.6	-0.3	84.8	84.8	0.0	85.0	84.8	0.2	
30	87.6	87.6	0.0	85.7	86.0	-0.3	85.9	85.8	0.1	
40	88.6	88.5	0.1	86.5	86.6	-0.1	86.7	86.6	0.1	
50	89.4	89.3	0.1	87.2	87.2	0.0	87.5	87.2	0.3	
60	90.1	90.1	0.0	87.8	87.9	-0.1	88.3	88.2	0.1	
70	90.8	90.9	-0.1	88.6	88.9	-0.3	89.1	89.3	-0.2	
80	91.6	91.7	-0.1	89.5	90.0	-0.5	90.1	90.2	-0.1	
90	92.8	93.0	-0.2	90.6	91.7	-1.1	91.4	91.9	-0.5	
95	93.9	94.3	-0.4	91.5	94.0	-2.5	92.5	94.0	-1.5	
98	95.0	96.0	-1.0	92.6	Н	-	93.6	н	-	
99	95.5	97.2	-1.7	93.7	Н	_	н	Н	_	

TABLE X

MAXIMUM RESEARCH, MOTOR, AND (R+M)/2 OCTANE NUMBER REQUIREMENTS

1980 U.S. and Imported Cars

b	D D		FBRU Fu	uels	1	FBRSU Fuels			
Percent <u>Satisfied</u>	PR <u>Fuels</u>	RON	MON	(R+M)/2	RON	MON	(R+M)/2		
10	83.8	85.2	79.8	82.5	86.3	78.6	82.4		
20	86.2	87.8	81.6	84.7	89.4	80.3	84.8		
30	87.5	89.0	82.3	85.6	90.5	80.9	85.7		
40	88.4	89.8	82.9	86.3	91.4	81.5	86.4		
50	89.2	90.6	83.4	87.0	92.4	82.0	87.2		
60	90.0	91.4	83.9	87.7	93.3	82.6	88.0		
70	90.6	92.4	84.4	88.4	94.5	83.2	88.8		
80	91.4	93.6	85.2	89.4	96.0	84.1	90.0		
90	92.7	95.1	86.2	90.6	97.5	85.0	91.3		
95	94.1	96.2	86.8	91.5	98.8	86.2	92.5		
98	95.1	97.8	87.9	92.8	100.3	87.5	93.9		
99	95.6	99.1	88.9	94.0	Н	Н	н		

TABLE XI

COMPARISON OF MAXIMUM RESEARCH OCTANE NUMBER REQUIREMENTS

1980 and 1979 U.S. and Imported Cars

Damaant	1	PR Fuel:	<u>s</u>	F <u>E</u>	RU Fuel	<u>s</u>	FBF	FBRSU Fuels		
Percent Satisfied	1980	1979		1980	1979	Δ	1980	1979	_Δ	
10	83.8	84.4	-0.6	85.2	85.8	-0.6	86.3	86.4	-0.1	
20	86.2	86.4	-0.2	87.8	88.2	-0.4	89.4	88.9	0.5	
30	87.5	87.5	0.0	89.0	89.7	-0.7	90.5	90.4	0.1	
40	88.4	88.5	-0.1	89.8	90.8	-1.0	91.4	91.6	-0.2	
50	89.2	89.2	0.0	90.6	91.7	-1.1	92.4	92.6	-0.2	
60	90.0	89.8	0.2	91.4	92.7	-1.3	93.3	93.6	-0.3	
70	90.6	90.6	0.0	92.4	93.7	-1.3	94.5	94.5	0.0	
80	91.4	91.6	-0.2	93.6	95.0	-1.4	96.0	95.8	0.2	
90	92.7	93.2	-0.5	95.1	96.9	-1.8	97.5	97.7	-0.2	
95	94.1	94.5	-0.4	96.2	98.5	-2.3	98.8	99.4	-0.6	
98	95.1	96.2	-1.1	97.8	100.6	-2.8	100.3	101.4*	-1.1	
99	95.6	97.4	-1.8	99.1	Н	-	н	н	_	

^{*} Extrapolated

TABLE XII

COMPARISON OF MAXIMUM MOTOR OCTANE NUMBER REQUIREMENTS

1980 and 1979 U.S. and Imported Cars

Dawsont	PR PR			FBF	RU Fuels	<u> </u>	FBRSU Fuels		
Percent <u>Satisfied</u>	1980	1979	Δ	1980	1979	_Δ_	1980	1979	Δ
10	83.8	84.4	-0.6	79.8	79.4	0.4	78.6	78.2	0.4
20	86.2	86.4	-0.2	81.6	80.8	8.0	80.3	79.9	0.4
30	87.5	87.5	0.0	82.3	81.5	0.8	80.9	80.8	0.1
40	88.4	88.5	-0.1	82.9	82.1	8.0	81.5	81.6	-0.1
50	89.2	89.2	0.0	83.4	82.6	8.0	82.0	82.2	-0.2
60	90.0	89.8	0.2	83.9	83.2	0.7	82.6	82.8	-0.2
70	90.6	90.6	0.0	84.4	84.0	0.4	83.2	83.4	-0.2
80	91.4	91.6	-0.2	85.2	84.8	0.4	84.1	84.3	-0.2
90	92.7	93.2	-0.5	86.2	86.4	-0.2	85.0	85.9	-0.9
95	94.1	94.5	-0.4	86.8	87.6	-0.8	86.2	87.5	-1.3
98	95.1	96.2	-1.1	87.9	89.3	-1.4	87.5	89.1	-1.6
99	95.6	97.4	-1.8	88.9	Н	-	н	Н	-

TABLE XIII

COMPARISON OF MAXIMUM (R+M)/2 OCTANE NUMBER REQUIREMENTS

1980 and 1979 U.S. and Imported Cars

Damasuk	PR Fuels		FE	RU Fue	<u>ls</u>	FBRSU Fuels			
Percent <u>Satisfied</u>	1980	1979	Δ	1980	1979	Δ	1980	1979	
10	83.8	84.4	-0.6	82.5	82.6	-0.1	82.4	82.3	0.1
20	86.2	86.4	-0.2	84.7	84.5	0.2	84.8	84.4	0.4
30	87.5	87.5	0.0	85.6	85.6	0.0	85.7	85.6	0.1
40	88.4	88.5	-0.1	86.3	86.4	-0.1	86.4	86.6	-0.2
50	89.2	89.2	0.0	87.0	87.2	-0.2	87.2	87.4	-0.2
60	90.0	89.8	0.2	87.7	88.0	-0.3	88.0	88.2	-0.2
70	90.6	90.6	0.0	88.4	88.8	-0.4	88.8	89.0	-0.2
80	91.4	91.6	-0.2	89.4	89.9	-0.5	90.0	90.0	0.0
90	92.7	93.2	-0.5	90.6	91.6	-1.0	91.3	91.8	-0.5
95	94.1	94.5	-0.4	91.5	93.0	-1.5	92.5	93.4	-0.9
98	95.1	96.2	-1.1	92.8	95.0	-2.2	93.9	95.2	-1.3
99	95.6	97.4	-1.8	94.0	Н	-	н	Н	-

TABLE XIV

MAXIMUM RESEARCH, MOTOR, AND (R+M)/2 OCTANE NUMBER REQUIREMENTS

1980 U.S. Vehicles

			FBRU F	uels	F	FBRSU Fuels	
Percent <u>Satisfied</u>	PR Fuels	RON	MON	(R+M)/2	RON	MON	(R+M)/2
10	85.3	86.8	80.9	83.9	88.3	79.8	84.0
20	87.0	88.8	82.2	85.5	90.3	80.8	85.5
30	88.2	89.8	82.8	86.3	91.4	81.4	86.4
40	89.1	90.6	83.4	87.0	92.4	82.0	87.2
50	89.8	91.4	83.8	87.6	93.4	82.6	88.0
60	90.4	92.3	84.4	88.3	94.5	83.2	88.8
70	91.1	93.2	85.0	89.1	95.6	83.9	89.7
80	91.9	94.2	85.6	89.9	96.6	84.5	90.6
90	93.0	95.5	86.4	90.9	98.1	85.5	91.8
95	94.1	96.5	87.0	91.7	99.1	86.4	92.7
98	95.2	98.0	88.1	93.1	100.2	87.4	93.8
99	95.6	99.6	89.3	94.4	н	н	Н

TABLE XV

COMPARISON OF MAXIMUM RESEARCH OCTANE NUMBER REQUIREMENTS

1980 and 1979 U.S. Vehicles

	PR Fuels			F	BRU Fue	ls	FBF	FBRSU Fuels			
Percent Satisfied	<u>1980</u>	1979		1980	1979		1980	1979	_Δ_		
10	85.3	85.6	-0.3	86.8	87.6	-0.8	88.3	88.7	-0.4		
20	87.0	87.1	-0.1	88.8	89.5	-0.7	90.3	90.2	0.1		
30	88.2	88.0	0.2	89.8	90.5	-0.7	91.4	91.4	0.0		
40	89.1	88.8	0.3	90.6	91.4	-0.8	92.4	92.2	0.2		
50	89.8	89.5	0.3	91.4	92.3	-0.9	93.4	93.2	0.2		
60	90.4	90.2	0.2	92.3	93.2	-0.9	94.5	94.2	0.3		
70	91.1	91.0	0.1	93.2	94.2	-1.0	95.6	95.2	0.4		
80	91.9	91.9	0.0	94.2	95.6	-1.4	96.6	96.5	0.1		
90	93.0	93.3	-0.3	95.5	97.4	-1.9	98.1	98.1	0.0		
95	94.1	94.7	-0.6	96.5	98.9	-2.4	99.1	99.6	-0.5		
98	95.2	96.4	-1.2	98.0	101.5	-3.5	100.2	102.0*	-1.8		
99	95.6	97.6	-2.0	99.6	н	_	н	н	_		

^{*} Extrapolated

TABLE XVI

COMPARISON OF MAXIMUM MOTOR OCTANE NUMBER REQUIREMENTS

1980 and 1979 U.S. Vehicles

Percent	PR Fuels			FBRU Fu	els	FBRSU Fuels			
Satisfied	1980	1979	Δ	1980	1979	Δ	1980	1979	
10	85.3	85.6	-0.3	80.9	80.4	0.5	79.8	79.1	0.7
20	87.0	87.1	-0.1	82.2	81.4	0.8	80.8	80.6	0.2
30	88.2	88.0	0.2	82.8	82.0	0.8	81.4	81.4	0.0
40	89.1	88.88	0.3	83.4	82.5	0.9	82.0	81.9	0.1
50	89.8	89.5	0.3	83.8	83.0	0.8	82.6	82.5	0.1
60	90.4	90.2	0.2	84.4	83.6	0.8	83.2	83.2	0.0
70	91.1	91.0	0.1	85.0	84.3	0.7	83.9	83.9	0.0
80	91.9	91.9	0.0	85.6	85.3	0.3	84.5	84.8	-0.3
90	93.0	93.3	-0.3	86.4	86.7	-0.3	85.5	86.2	-0.7
95	94.1	94.7	-0.6	87.0	87.9	-0.9	86.4	87.7	-1.3
98	95.2	96.4	-1.2	88.1	90.0	-1.9	87.4	89.6*	-2.2
99	95.6	97.6	-2.0	89.3	Н	-	Н	Н	-

^{*} Extrapolated

TABLE XVII

COMPARISON OF MAXIMUM (R+M)/2 OCTANE NUMBER REQUIREMENTS
1980 and 1979 U.S. Vehicles

_	PR Fuels				FBRU Fue	els	FBRSU Fuels			
Percent <u>Satisfied</u>	1980	1979		1980	1979	Δ	1980	1979		
10	85.3	85.6	-0.3	83.9	84.0	-0.1	84.0	83.9	0.1	
20	87.0	87.1	-0.1	85.5	85.4	0.1	85.5	85.4	0.1	
30	88.2	0,88	0.2	86.3	86.2	0.1	86.4	86.4	0.0	
40	89.1	88.88	0.3	87.0	87.0	0.0	87.2	87.0	0.2	
50	89.8	89.5	0.3	87.6	87.6	0.0	88.0	87.8	0.2	
60	90.4	90.2	0.2	88.3	88.4	-0.1	88.8	88.7	0.1	
70	91.1	91.0	0.1	89.1	89.2	-0.1	89.7	89.6	0.1	
80	91.9	91.9	0.0	89.9	90.4	-0.5	90.6	90.6	0.0	
90	93.0	93.3	-0.3	90.9	92.0	-1.1	91.8	92.2	-0.4	
95	94.1	94.7	-0.6	91.7	93.4	-1.7	92.7	93.6	-0.9	
98	95.2	96.4	-1.2	93.1	95.8	-2.7	93.8	95.8	-2.0	
99	95.6	97.6	-2.0	94.4	Н	-	Н	Н	-	

TABLE XVIII

MAXIMUM RESEARCH, MOTOR, AND (R+M)/2 OCTANE NUMBER REQUIREMENTS

1980 U.S. Cars

			BRU Fue	215	FE	BRSU Fue	21s
Percent <u>Satisfied</u>	PR Fuels	RON	MON	(R+M)/2	RON	MON	(R+M)/2
10	85.1	86.5	80.7	83.6	87.8	79.5	83.6
20	86.9	88.88	82.2	85.5	90.2	80.7	85.4
30	88.1	89.7	82.8	86.3	91.2	81.3	86.3
40	89.0	90.5	83.3	86.9	92.2	81.9	87.0
50	89.6	91.3	83.8	87.5	93.1	82.5	87.8
60	90.2	92.1	84.2	88.1	94.2	83.1	88.6
70	90.8	93.1	84.8	89.0	95.3	83.7	89.5
80	91.7	94.2	85.6	89.9	96.5	84.4	90.4
90	93.0	95.5	86.4	90.9	97.9	85.4	91.7
95	94.4	96.6	87.1	91.8	99.1	86.4	92.7
98	95.3	98.3	88.3	93.3	100.6	87.6	94.1
99	95.7	н	н	н	Н	н	н

TABLE XIX

COMPARISON OF MAXIMUM RESEARCH OCTANE NUMBER REQUIREMENTS

1980 and 1979 U.S. Cars

Davisand	<u> </u>	PR Fuels			BRU Fue	ls	FB	FBRSU Fuels			
Percent Satisfied	1980	1979	Δ	1980	1979	Δ	1980	1979			
10	85.1	85.4	-0.3	86.5	87.7	-1.2	87.8	88.4	-0.6		
20	86.9	87.0	-0.1	88.8	89.5	-0.7	90.2	90.4	-0.2		
30	88.1	88.1	0.0	89.7	90.7	-1.0	91.2	91.5	-0.3		
40	89.0	88.9	0.1	90.5	91.6	-1.1	92.2	92.5	-0.3		
50	89.6	89.7	-0.1	91.3	92.5	-1.2	93.1	93.5	-0.4		
60	90.2	90.4	-0.2	92.1	93.2	-1.1	94.2	94.4	-0.2		
70	90.8	91.2	-0.4	93.1	94.5	-1.4	95.3	95.5	-0.2		
80	91.7	92.1	-0.4	94.2	95.6	-1.4	96.5	96.7	-0.2		
90	93.0	93.5	-0.5	95.5	97.4	-1.9	97.9	98.3	-0.4		
95	94.4	94.9	-0.5	96.6	98.8	-2.2	99.1	99.0	0.1		
98	95.3	96.6	-1.3	98.3	101.0	-2.7	100.6	Н	•		
99	95.7	97.8	-2.1	н	н	-	Н	Н	-		

TABLE XX

COMPARISON OF MAXIMUM MOTOR OCTANE NUMBER REQUIREMENTS

1980 and 1979 U.S. Cars

Danaant	F	PR Fuels			RU Fue	ls	FBF	FBRSU Fuels			
Percent <u>Satisfied</u>	1980	1979		1980	1979	Δ	1980	1979			
10	85.1	85.4	-0.3	80.7	80.5	0.2	79.5	79.6	-0.1		
20	86.9	87.0	-0.1	82.2	81.4	0.8	80.7	80.8	-0.1		
30	88.1	88.1	0.0	82.8	82.1	0.7	81.3	81.5	-0.2		
40	89.0	88.9	0.1	83.3	82.6	0.7	81.9	82.1	-0.2		
50	89.6	89.7	-0.1	83.8	83.1	0.7	82.5	82.7	-0.2		
60	90.2	90.4	-0.2	84.2	83.6	0.6	83.1	83.3	-0.2		
70	90.8	91.2	-0.4	84.8	84.5	0.3	83.7	84.2	-0.5		
80	91.7	92.1	-0.4	85.6	85.3	0.3	84.4	85.0	-0.6		
90	93.0	93.5	-0.5	86.4	86.7	-0.3	85.4	86.4	-1.0		
95	94.4	94.9	-0.5	87.1	87.8	-0.7	86.4	87.1	-0.7		
98	95.3	96.6	-1.3	88.3	89.6	-1.3	87.6	Н	-		
99	95.7	97.8	-2.1	н	Н	-	Н	Н	-		

TABLE XXI

COMPARISON OF MAXIMUM (R+M)/2 OCTANE NUMBER REQUIREMENTS

1980 and 1979 U.S. Cars

Donant		PR Fuels	<u>s</u>	F	BRU Fue	ls	FBRSU Fuels			
Percent <u>Satisfied</u>	1980	1979	Δ_	1980	1979		1980	1979	Δ_	
10	85.1	85.4	-0.3	83.6	84.1	-0.5	83.6	84.0	-0.4	
20	86.9	87.0	-0.1	85.5	85.4	0.1	85.4	85.6	-0.2	
30	88.1	88.1	0.0	86.3	86.4	-0.1	86.3	86.5	-0.2	
40	89.0	88.9	0.1	86.9	87.1	-0.2	87.0	87.3	-0.3	
50	89.6	89.7	-0.1	87.5	87.8	-0.3	87.8	88.0	-0.2	
60	90.2	90.4	-0.2	88.1	88.4	-0.3	88.6	88.8	-0.2	
70	90.8	91.2	-0.4	89.0	89.5	-0.5	89.5	89.8	-0.3	
80	91.7	92.1	-0.4	89.9	90.4	-0.5	90.4	90.8	-0.4	
90	93.0	93.5	-0.5	90.9	92.0	-1.1	91.7	92.4	-0.7	
95	94.4	94.9	-0.5	91.8	93.3	-1.5	92.7	93.0	-0.3	
98	95.3	96.6	-1.3	93.3	95.3	-2.0	94.1	н	-	
99	95.7	97.8	-2.1	Н	Н	-	Н	Н	_	

TABLE XXII

MAXIMUM RESEARCH, MOTOR, AND (R+M)/2 OCTANE NUMBER REQUIREMENTS

1980 Imported Vehicles

D	20	FBRU Fuels				FBRSU Fuels			
Percent Satisfied	PR <u>Fuels</u>	RON	MON	(R+M)/2	RON	MON	(R+M)/2		
10	79.4	81.7	77.3	79.5	82.3	75.8	79.0		
20	84.5	85.7	80.2	82.9	87.3	79.2	83.3		
30	86.1	87.4	81.3	84.4	89.2	80.2	84.7		
40	87.3	88.3	81.9	85.1	90.0	80.6	85.3		
50	88.0	89.0	82.3	85.6	90.8	81.1	86.0		
60	88.8	89.8	82.9	86.4	91.7	81.6	86.7		
70	89.7	90.8	83.5	87.2	92.6	82.2	87.4		
80	90.5	91.6	84.0	87.8	93.7	82.8	88.3		
90	91.5	92.6	84.6	88.6	95.0	83.5	89.2		
95	92.8	94.1	85.6	89.8	95.9	84.0	90.0		
98	94.2	95.4	86.4	90.9	99.1	86.4	92.8		
99	94.8	96.4	86.9	91.7	100.2	87.3	93.8		

TABLE XXIII

COMPARISON OF MAXIMUM RESEARCH OCTANE NUMBER REQUIREMENTS

1980 and 1979 Imported Vehicles

0		PR Fuels				FBRU Fuels				FBRSU Fuels				
Percent Satisfied	1980	1979		19	<u>80</u>	1979		Δ	_	1980	1	979		<u></u>
10	79.4	80.3	-0.9	81	.7	81.7	(0.0		82.3	8	2.9	-0.	6
20	84.5	83.4	1.1	85	.7	84.2	,	1.5		87.3	8	4.9	2.	4
30	86.1	85.4	0.7	87	.4	85.6	•	8.1		89.2	8	6.0	3.	2
40	87.3	86.4	0.9	88	.3	87.1	•	1.2		90.0	8	8.0	2.	0
50	88.0	87.5	0.5	89	.0	88.9	(1.0		90.8	8	9.3	٦.	5
60	88.8	89.2	-0.4	89	.8	90.5	-(0.7		91.7	9	0.5	1.	. 2
70	89.7	89.9	-0.2	90	.8	91.4	-(0.6		92.6	9	1.6	1.	0
80	90.5	90.6	-0.1	91	.6	92.4	-1	8.0		93.7	9	2.8	0.	,9
90	91.5	91.5	0.0	92	.6	93.9	_,	1.3		95.0	9	4.9	0	.1
95	92.8	92.0	0.8	94	.1	н		_		95.9		Н		
98	94.2	92.5*	1.7	95	.4	н		_		99.1		Н	-	
99	94.8	92.8*	2.0	96	.4	н		_	•	100.2		Н	•	

*Extrapolated

TABLE XXIV

COMPARISON OF MAXIMUM MOTOR OCTANE NUMBER REQUIREMENTS

1980 and 1979 Imported Vehicles

Dawaant	F	PR Fuels		FB	RU Fuel:	<u>s</u>	FBRSU Fuels			
Percent <u>Satisfied</u>	1980	1979	_Δ_	1980	1979		1980	1979		
10	79.4	80.3	-0.9	77.3	76.8	0.5	75.8	75.8	0.0	
20	84.5	83.4	1.1	80.2	78.4	1.8	79.2	77.4	1.8	
30	86.1	85.4	0.7	81.3	79.3	2.0	80.2	78.0	2.2	
40	87.3	86.4	0.9	81.9	80.1	1.8	80.6	79.3	1.3	
50	88.0	87.5	0.5	82.3	81.1	1.2	81.1	80.1	1.0	
60	88.8	89.2	-0.4	82.9	82.0	0.9	81.6	80.9	0.7	
70	89.7	89.9	-0.2	83.5	82.5	1.0	82.2	81.6	0.6	
80	90.5	90.6	-0.1	84.0	83.0	1.0	82.8	82.3	0.5	
90	91.5	91.5	0.0	84.6	84.1	0.5	83.5	83.7	-0.2	
95	92.8	92.0	0.8	85.6	Н	-	84.0	Н	-	
98	94.2	92.5*	1.7	86.4	Н	-	86.4	н	-	
99	94.8	92.8*	2.0	86.9	Н	-	87.3	н	-	

^{*} Extrapolated

TABLE XXV

COMPARISON OF MAXIMUM (R+M)/2 OCTANE NUMBER REQUIREMENTS

1980 and 1979 Imported Vehicles

Downant	F	R Fuels			FBRU Fue	ls	FBR:	U Fuel	<u>s</u>
Percent <u>Satisfied</u>	1980	1979	_Δ_	1980	1979		1980	1979	
10	79.4	80.3	-0.9	79.5	79.2	0.3	79.0	79.4	-0.4
20	84.5	83.4	1.1	82.9	81.3	1.6	83.3	81.2	1.1
30	86.1	85.4	0.7	84.4	82.4	2.0	84.7	82.0	2.7
40	87.3	86.4	0.9	85.7	83.6	1.5	85.3	83.6	1.7
50	88.0	87.5	0.5	85.6	85.0	0.6	86.0	84.7	1.3
60	88.8	89.2	-0.4	86.4	86.2	0.2	86.7	85.7	1.0
70	89.7	89.9	-0.2	87.2	87.0	0.2	87.4	86.6	8.0
80	90.5	90.6	-0.1	87.8	87.7	0.1	88.3	87.6	0.7
90	91.5	91.5	0.0	88.6	89.0	-0.4	89.2	89.3	-0.7
95	92.8	92.0	8.0	89.8	н	-	90.0	Н	-
98	94.2	92.5*	1.7	90.9	н	-	92.8	н	-
99	94.8	92.8*	2.0	91.7	н	-	93.8	н	~

^{*} Extrapolated

TABLE XXVI

ENGINE SPEEDS FOR MAXIMUM OCTANE NUMBER REQUIREMENTS - 1980 SELECT MODELS

% of Cars Having Requirements Within Specified Speed (rpm) Ranges

NIJ 244	PR FBRU FBRSU	92 75 66 8 17 17 17	12 12 12	PC 137/KC 137/DC 137	PR FBRU FBRSU	73 60 60 27 27 20 13 13	15 15 15
NC7 228/HC7 228/ IC7 228/LC7 228	PR FBRU FBRSU	14 5 24 29 33 62 47 53 19 14	21 21 21	0 V250/M V250	PR FBRU FBRSU	29 28 21 57 36 50 14 36 22	14 14 14
NC5 225/HC5 225/ Model: IC5 225/LC5 225	Fuel: PR FBRU FBRSU	21 17 21 58 41 37 17 29 25 4 13 17	24 24 24	Model: 0CA 242/MCA 242	Fuel: PR FBRU FBRSU	7 14 14 79 86 72 14 14	14 14 14
ž	SPEED RANGE	1599 and Lower 1600 - 1999 2000 - 2399 2400 - 2799 2800 - 3199 3200 and Higher	No. of Cars	¥	SPEED RANGE	1599 and Lower 1600 - 1999 2000 - 2399 2400 - 2799 2800 - 3199 3200 and Higher	No. of Cars

TABLE XXVII

ENGINE SPEEDS FOR MAXIMUM AND PART-THROTTLE

OCTANE NUMBER REQUIREMENTS

Weighted % of Vehicles Having Requirements in Indicated (rpm) Ranges

1980 U.S. and Imported Vehicles

Engine Speed Range (rpm)	PR <u>Fuels</u>	FBRU Fuels	FBRSU Fuels
Maximum Octane Number Requirements			
1599 and Lower 1600 - 1999 2000 - 2399 2400 - 2799 2800 - 3199 3200 and Higher	14.7 37.6 23.8 14.8 7.4 1.7	11.5 30.3 24.1 15.3 11.7 7.1	9.2 25.4 21.4 18.1 15.8 10.1
Part-Throttle Octane Number Requirements			
1599 and Lower 1600 - 1999 2000 - 2399 2400 - 2799 2800 - 3199 3200 and Higher	- - - -	25.1 36.9 19.9 11.7 2.4 4.0	-

TABLE XXVIII

VEHICLES HAVING FBRU PART-THROTTLE REQUIREMENTS

FULL-THROTTLE REQUIREMENTS

1980 and 1979 U.S. and Imported Vehicles

	No. Vehicles Tested	No. Vehicles Knocking	% of Vehicles Knocking
1980 U.S. and Imported Vehicles	389	62 (26)*	15.9 (6.7)
1979 U.S. and Imported Vehicles	453	66	14.6

^{* ()} indicated greater than full throttle requirement.

TABLE XXIX

1980 U.S. and Imported Vehicles (389 Vehicles)

Percent <u>Satisfied</u>	Research Octane Number	Motor Octane <u>Number</u>	(R+M)/2 Octane Number
10	<78	-	-
20	80.3	76.2	78.2
30	82.8	78.1	80.5
40	84.9	79.6	82.2
50	86.4	80.6	83.5
60	87.8	81.5	84.6
70	89.4	82.6	86.0
80	90.9	83.5	87.2
90	93.1	84.9	89.0
95	94.7	85.9	90.3

TABLE XXX

1980 U.S. and Imported Cars (375 Cars)

Percent <u>Satisfied</u>	Research Octane Number	Motor Octane Number	(R+M)/2 Octane Number
10	<78	-	-
20	79.7	75.7	77.7
30	82.4	77.8	80.1
40	84.6	79.4	82.0
50	86.4	80.6	83.5
60	87.8	81.5	84.6
70	89.2	82.5	85.8
80	90.7	83.4	87.0
90	92.8	84.7	88.8
95	94.5	85.8	90.2

TABLE XXXI

1980 U.S. Vehicles

(312 Vehicles)

Percent Satisfied	Research Octane Number	Motor Octane Number	(R+M)/2 Octane <u>Number</u>
10	<78	-	-
20	81.4	77.0	79.2
30	83.8	78.8	81.3
40	85.2	79.8	82.5
50	86.5	80.7	83.6
60	87.8	81.6	84.7
70	89.5	82.7	86.1
80	91.3	83.8	87.5
90	93.7	85.3	89.5
95	95.2	86.2	90.7

TABLE XXXII

1980 U.S. Cars

(296 Cars)

Percent Satisfied	Research Octane Number	Motor Octane Number	(R+M)/2 Octane Number
10	<78	-	-
20	81.3	76.9	79.1
30	83.6	78.6	81.1
40	85.1	79.8	82.4
50	86.5	80.7	83.6
60	87.8	81.6	84.7
70	89.4	82.6	86.0
80	90.9	83.6	87.2
90	93.5	85.1	89.3
95	94.8	86.0	90.4

TABLE XXXIII

Percent Satisfied	Research Octane Number	Motor Octane Number	(R+M)/2 Octane Number
10	-	-	•
20	<78	-	-
30	79.5	75.6	77.5
40	82.3	77.7	80.0
50	85.7	80.2	83.0
60	87.7	81.5	84.6
70	89.0	82.3	85.6
80	90.3	83.2	86.8
90	91.6	83.9	87.8
95	92.3	84.4	88.4

TABLE XXXIV

COMPARISON OF MAXIMUM WITH PART-THROTTLE FBRU RESEARCH OCTANE NUMBER REQUIREMENTS

1980 U.S. and Imported Vehicles

Percent <u>Satisfied</u>	Maximum Octane Number (429 Veh)	Part-Throttle Octane Number (389 Veh)	
10	85.6	<78	-
20	88.0	80.3	7.7
30	89.1	82.8	6.3
40	90.0	84.9	5.1
50	90.8	86.4	4.4
60	91.7	87.8	3.9
70	92.6	89.4	3.2
80	93.7	90.9	2.8
90	95.1	93.1	2.0
95	96.1	94.7	1.4

TABLE XXXV

COMPARISON OF PART-THROTTLE FBRU OCTANE NUMBER REQUIREMENTS

1980 and 1979 U.S. and Imported Vehicles
1980 and 1979 U.S. Vehicles

	<u> </u>	.S. an	d Impo	rted Ve	hicles				<u>U.S. V</u>	<u>ehicles</u>		
.		RON			MON			RON			MON	
Percent <u>Satisfied</u>	1980	<u>1979</u>	Δ	1980	<u>1979</u>		<u>1980</u>	<u>1979</u>		1980	<u>1979</u>	
10	<78	<78	-	•	-	-	<78	78.4	-	-	74.5	-
20	80.3	81.4	-1.1	76.2	76.6	-0.4	81.4	83.2	-1.8	77.0	77.8	-0.8
30	82.8	84.2	-1.4	78.1	78.4	-0.3	83.8	85.6	-1.8	78.8	79.3	-0.5
40	84.9	86.4	-1.5	79.6	79.7	-0.1	85.2	87.2	-2.0	79.8	80.1	-0.3
50	86.4	88.2	-1.8	80.6	80.8	-0.2	86.5	88.8	-2.3	80.7	81.0	-0.3
60	87.8	89.6	-1.8	81.5	81.5	0.0	87.8	90.0	-2.2	81.6	81.7	-0.1
70	89.4	90.8	-1.4	82.6	82.1	0.5	89.5	91.1	-1.6	82.7	82.3	0.4
80	90.9	92.2	-1.3	83.5	82.9	0.6	91.3	92.4	-1.1	83.8	83.0	0.8
90	93.1	94.4	-1.3	84.9	84.4	0.5	93.7	94.5	-0.8	85.3	84.5	0.8
95	94.7	97.6	-2.9	85.9	86.8	-0.9	95.2	96.9	-1.7	86.2	86.4	-0.2

OWNER-OBSERVER COMPARISON OF TANK FUEL KNOCK

(1973-1980 CRC Octane Number Requirement Surveys)

	1980	1979	1978	1977		1975	1974	1973
Fuel:	Unleaded	Unleaded**	Unleaded**	Unleaded**	Unleaded	Unleaded	Mixed*	Mixed*
(No. of Reports)	(218)	(961)	(105)	(225)	(200)	(216)	(170)	(238)
% Knocking								
Trained Observer	51.1	52.6	50.5	54.7	63.8	89.4	24.7	91
Owner	31.2	26.0	32.4	29.3	40.5	21.8	11.2	·54- 0L
% Owners Objecting								
Based on Total Reports	15.1	15.8	15.2	10.2	20.0	9.7	4.1	4
Based on Those Reporting Knock	48.5	8.09	46.9	34.8	49.4	44.5	36.6	40
Owner-Observer Ratio	0.61	0.49	0.64	0.54	0.63	0.24	0.45	0.59

* Mixed: Premium, regular, and subregular grades.

^{**} Some vehicles were designed for leaded fuels.

TABLE XXXVII

TANK FUEL KNOCK REPORTED BY TRAINED OBSERVERS

I. 1980 Select Models

		N	Cars Tested on Tank Fuel			
	Model	No. in <u>Survey</u>	No. Tested*	No. Knocking	% Knocking	
	NC5 225/HC5 225/ IC5 225/LC5 225	24	23	15	65.2	
	NC7 228/HC7 228/ IC7 228/LC7 228	21	20	1	5.0	
	NIJ 244	12	11	10	90.9	
	OCA 242/MCA 242	14	11	7	63.6	
	0 V250/M V250	14	11	7	63.6	
	PC 137/KC 137/DC 137	15	15	10	66.7	
II.	All Vehicles			<u>(We</u>	% Knocking ighted Population)	
	1980	429	374		49.9	
	1979	490	414		47.3	
	1978	434	338		47.2	
	1977	478	457		44.2	

^{*} Tank fuel tests were optional when owner questionnaires were not obtained.

TABLE XXXVIII

1980 VEHICLES REPORTED TO AFTER-RUN ON TANK FUEL

	Total Observations		Both Owner/Rater Data No Spark Adjustment	
	<u>Owner</u>	Rater	<u>Owner</u>	Rater
Vehicles Tested	218	404	180	180
After-Run Reported	25	10	20	3

AFTER-RUN REPORTED BY OWNER

(Vehicle Received with Spark at Manufacturer's Recommended Setting)

		FBRU	Tank Fuel		
Obs. No.	Vehicle <u>Code</u>	Maximum RON <u>Requirement</u>	RON	MON	
282	KL 21 7M	94.0*	91.2	83.3	
106	KC 137	- 96.0	94.3	83.7	
297	NC5 225	98.0	92.2	82.1	
60	LC7 228	87.0	91.0	83.4	
64	LC5 225	93.0	94.8	83.8	
65	LC5 225M	95.0	94.5	83.7	
286	LC7 228	86.0	95.1	85.1	
32	LIA 238	90.0	91.4	83.5	
253	MCA 133	89.0	94.4	84.4	
254	MW V258	92.0	92.0	83.3	
120	NLV 225M	92.0	93.1	83.4	
78	NC7 228	87.0	93.0	83.0	
387	NC5 225	98.0*	93.6	84.5	
61	OCA 223	94.5	90.9	83.4	
242	01 250	94.0	92.0	ND	
112	PL 217	93.0	94.8	84.6	
81	PL 217M	89.0	93.3	84.0	
268	SW V258S	94.0	91.5	83.0	
68	W 216M	91.0*	94.2	84.7	
293	Z 214M	88.0	92.6	84.2	

* = Part-throttle ND = No data reported

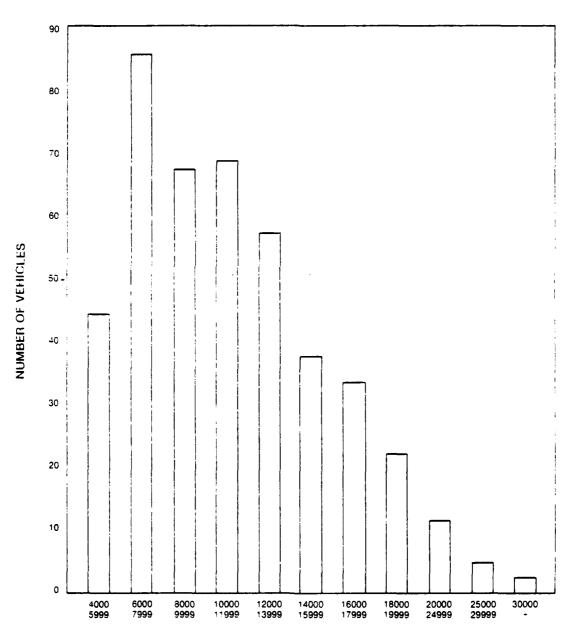
TABLE XXXIX

ROAD OCTANE DEPRECIATION OF 1980 FBRU AND FBRSU FUELS

1980 U.S. and Imported Vehicles

	FBRU Fuels			FBRSU Fuels				
RON	% Satisfied	Sensi- tivity	Road Octane Rating	Depre- ciation	Satisfied	Sensi- tivity	Road Octane Rating	Depre- ciation
84	6.2	5.1	82.2	1.8	4.9	7.0	81.1	2.9
85	8.3	5.3	83.4	1.6	6.1	7.3	82.1	2.9
86	11.1	5.6	84.6	1.4	8.4	7.6	83.5	2.5
87	14.5	6.0	85.4	1.6	10.5	8.0	84.3	2.7
88	20.1	6.3	86.2	1.8	12.5	8.4	85.0	3.0
89	28.9	6.7	87.5	1.5	16.0	8.9	85.7	3.3
90	40.3	7.0	88.6	1.4	23.5	9.4	86.8	3.2
91	51.7	7.4	89.5	1.5	33.0	9.8	88.0	3.0
92	64.0	7.8	90.4	1.6	42.8	10.2	88.9	3.1
93	73.9	8.2	91.1	1.9	53.1	10.6	89.6	3.4
94	82.0	8.5	91.9	2.1	62.7	11.0	90.3	3.7
95	89.5	8.9	92.9	2.1	71.2	11.5	90.9	4.1
96	94.5	9.3	93.8	2.2	79.0	11.9	91.6	4.4
97	97.3	9.7	94.7	2.3	86.9	12.3	92.5	4.5
98	98.5	9.9	95.3	2.7	91.3	12.6	93.1	4.9
99	99.1	10.2	95.6	3.4	95.5	12.7	94.1	4.9
100	99.4	10.4	95.8	4.2	98.0	12.7	95.1	4.9
101	-	-	-	-	98.8	13.1	95.4	4.6

FIGURE 1
DISTRIBUTION OF ODOMETER MILEAGE
FOR 1980 MODEL VEHICLES TESTED



ODOMETER MILEAGE INCREMENTS

FIGURE 2a

DISTRIBUTION OF MAXIMUM RON REQUIREMENTS 1980 U.S. AND IMPORTED VEHICLES

PR FUEL 429 VEHICLES
FBRU FUEL 429 VEHICLES
FBRSU FUEL 429 VEHICLES

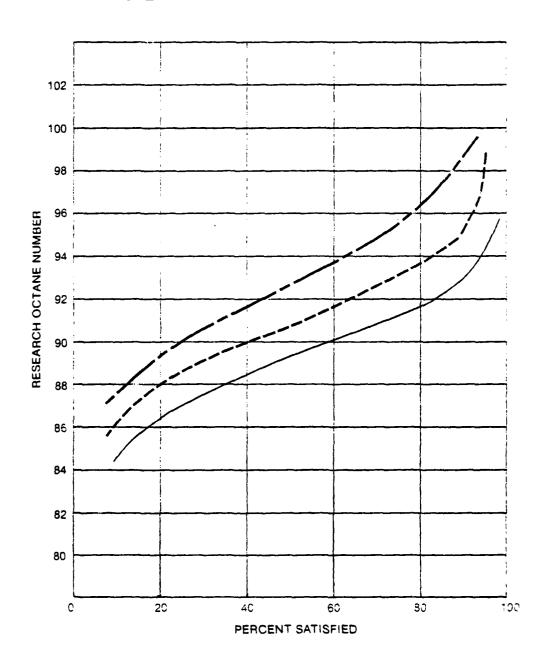
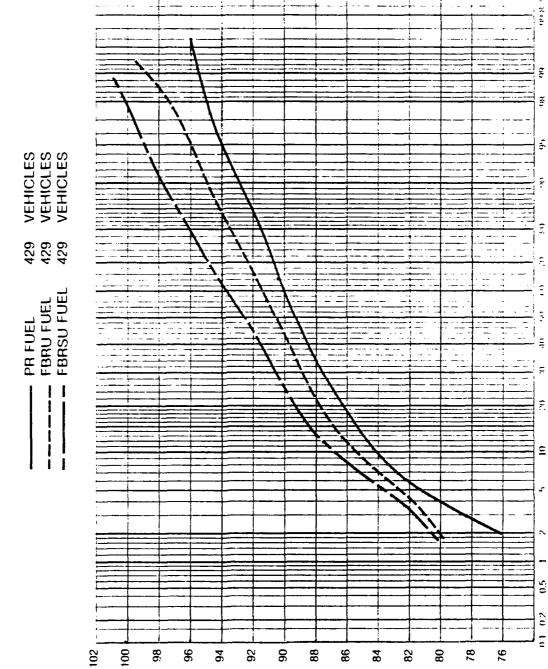


FIGURE 2h

DISTRIBUTION OF MAXIMUM RON REQUIREMENTS 1980 U.S. AND IMPORTED VEHICLES



RESEARCH OCTANE NUMBER

PERCENT SATISTIED

FIGURE 3

COMPARISON OF MAXIMUM PR FUEL REQUIREMENTS 1980 AND 1979 U.S. AND IMPORTED VEHICLES

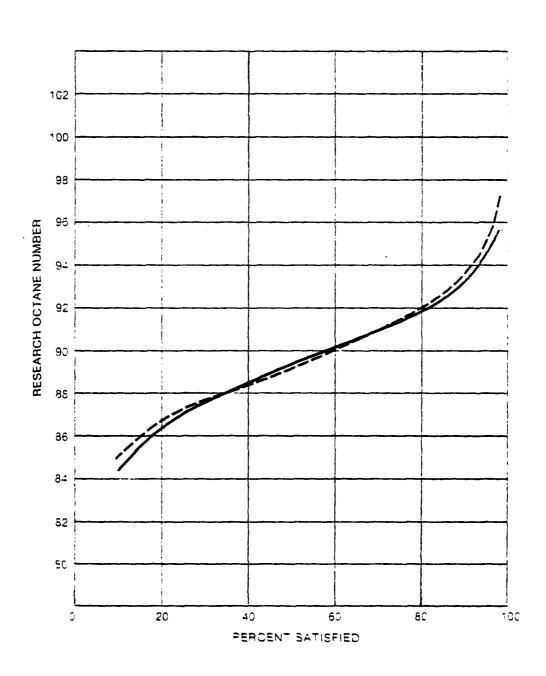


FIGURE 4

COMPARISON OF

MAXIMUM FBRU FUEL RON REQUIREMENTS
1980 AND 1979 U.S. AND IMPORTED VEHICLES

1980 SURVEY 429 VEHICLES

_.1979 SURVEY 490 VEHICLES

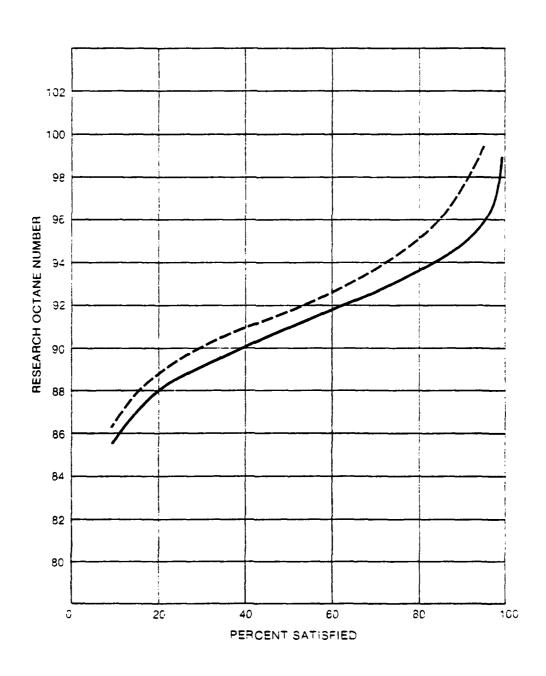


FIGURE 5

COMPARISON OF MAXIMUM FBRSU FUEL RON REQUIREMENTS 1980 AND 1979 U.S. AND IMPORTED VEHICLES

______1980 SURVEY: 429 VEHICLES ______1979 SURVEY: 478 VEHICLES

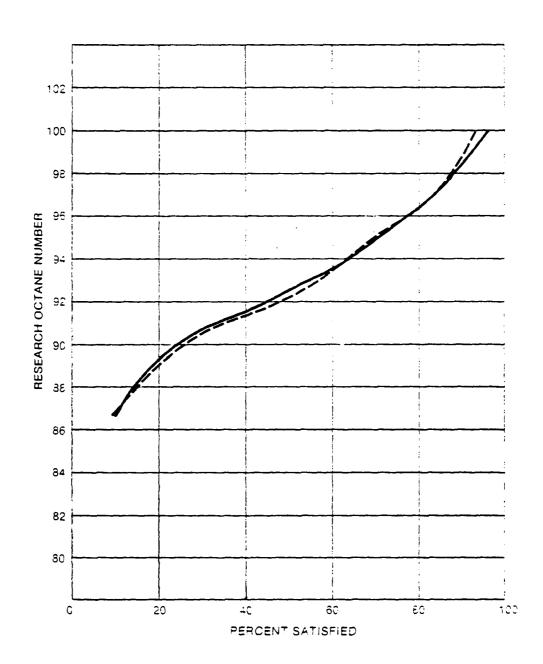
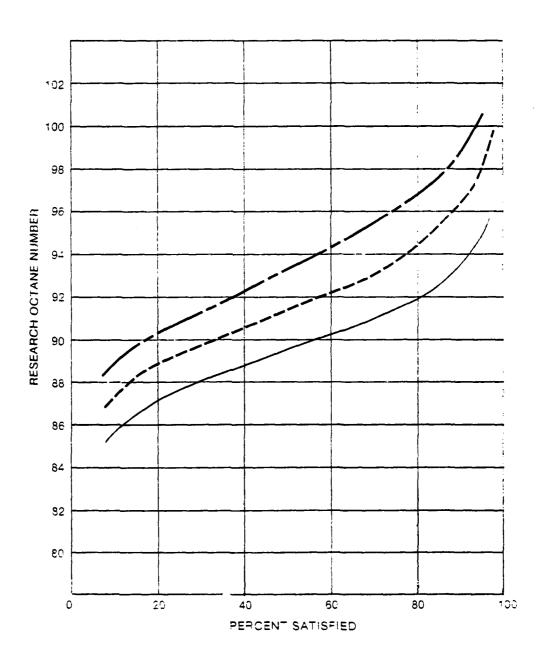


FIGURE 6a

DISTRIBUTION OF MAXIMUM RON REQUIREMENTS 1980 U.S. VEHICLES



DISTRIBUTION OF MAXIMUM RON REQUIREMENTS
1980 U.S. VEHICLES
PR FUEL 344 VEHICLES
FBRU FUEL 344 VEHICLES
FBRSU FUEL 344 VEHICLES 0.5 0.01.07.00 0 RESEARCH OCTANE NUMBER

PERCENT SATISFIED

FIGURE 7

COMPARISON OF MAXIMUM PR FUEL REQUIREMENTS 1980 AND 1979 U.S. VEHICLES

______1980 SURVEY 344 VEHICLES 423 VEHICLES

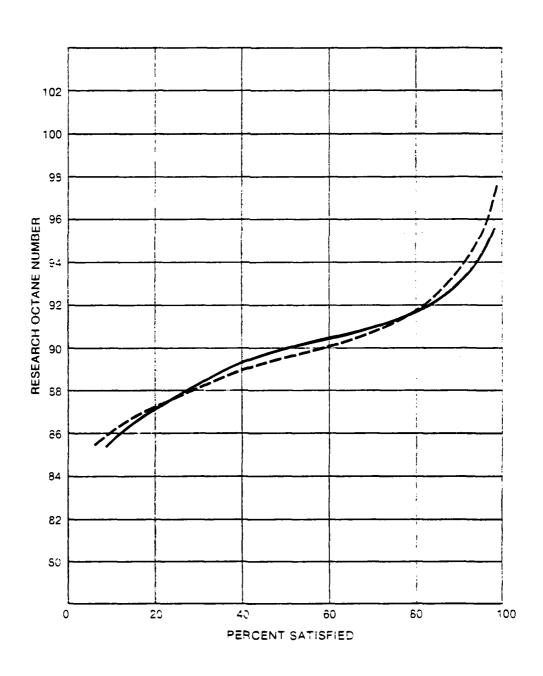


FIGURE 8

COMPARISON OF MAXIMUM FBRU FUEL REQUIREMENTS 1980 AND 1979 U.S. VEHICLES

______1980 SURVEY 344 VEHICLES 435 VEHICLES

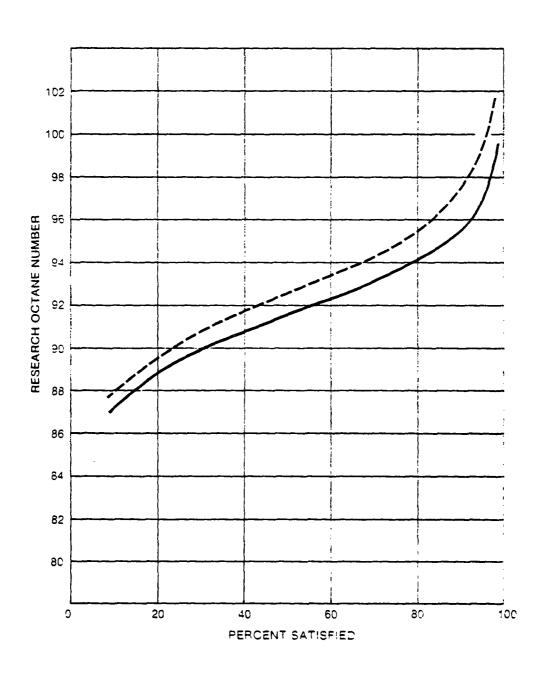


FIGURE 9

COMPARISON OF MAXIMUM FBRSU FUEL REQUIREMENTS 1980 AND 1979 U.S. VEHICLES

______1980 SURVEY 344 VEHICLES _____1979 SURVEY 423 VEHICLES

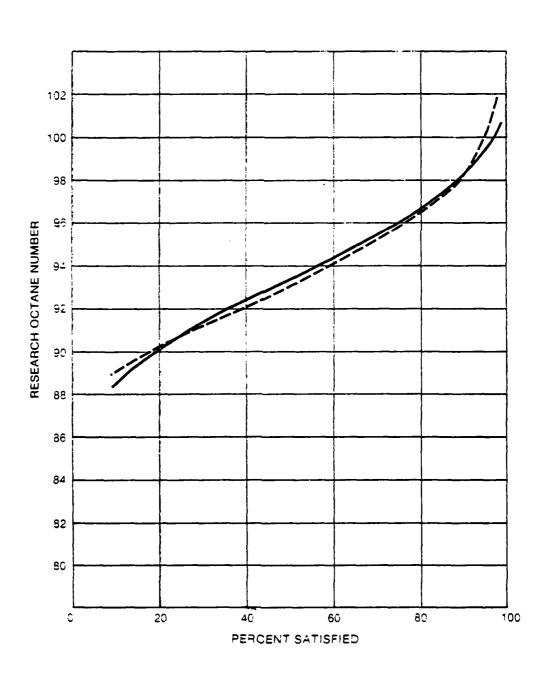
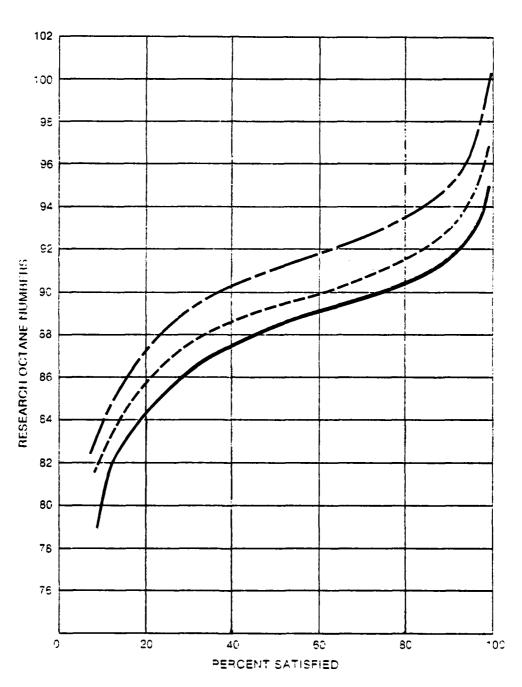


FIGURE 10a

DISTRIBUTION OF MAXIMUM RON REQUIREMENTS 1980 IMPORTED VEHICLES

PR FUEL 85 VEHICLES
FBRU FUEL 85 VEHICLES
FBRSU FUEL 85 VEHICLES





DISTRIBUTION OF MAXIMUM RON REQUIREMENTS 1980 IMPORTED VEHICLES

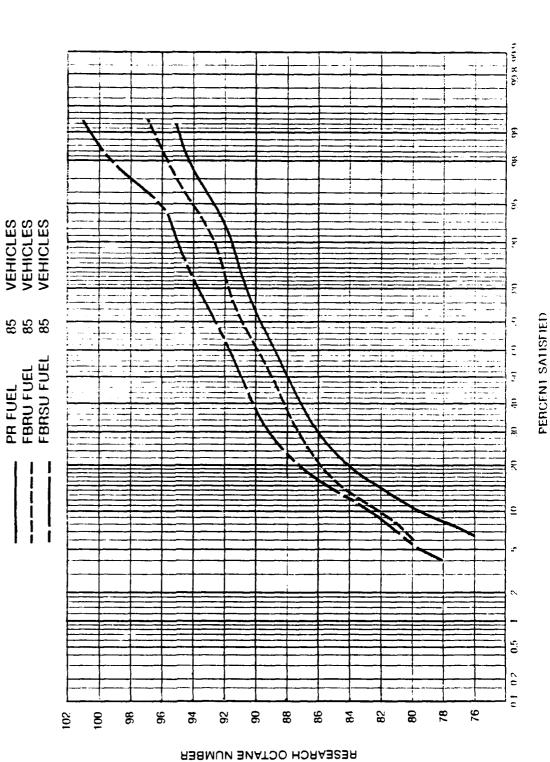
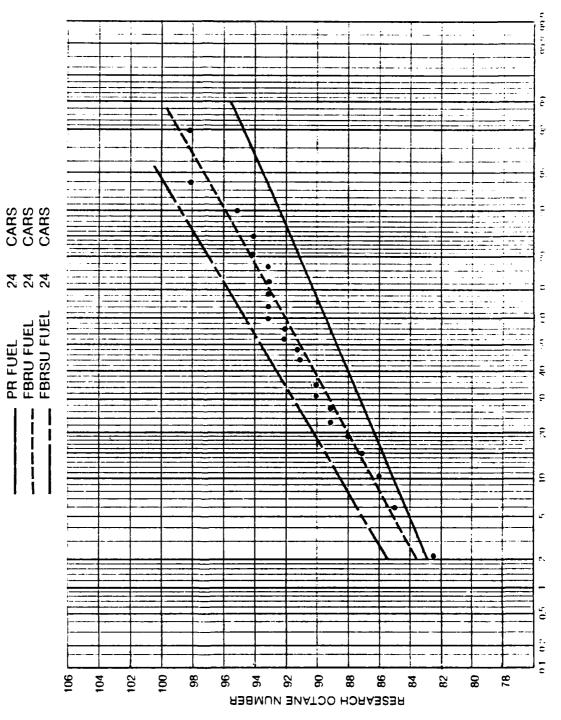


FIGURE 11

DISTRIBUTION OF

MAXIMUM RESEARCH OCTANE NUMBER REQUIREMENTS
1980 MODEL NC5 225/HC5 225/IC5 225/LC5 225

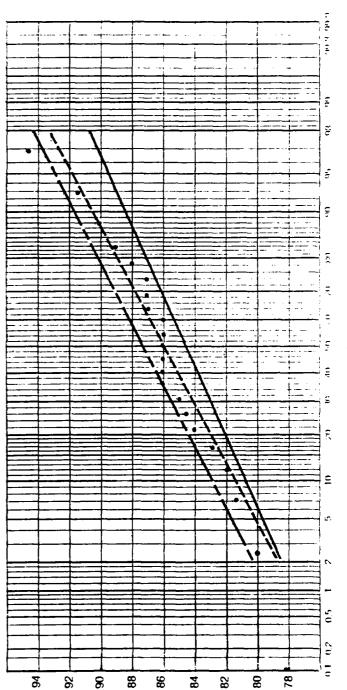


PERCENT SATISFIED

FIGURE 12

DISTRIBUTION OF MAXIMUM RESEARCH OCTANE NUMBER REQUIREMENTS 1980 MODEL NC7 228/HC7 228/IC7 228/LC7 228

PR FUEL 21 CARS
FBRU FUEL 21 CARS
FBRSU FUEL 21 CARS



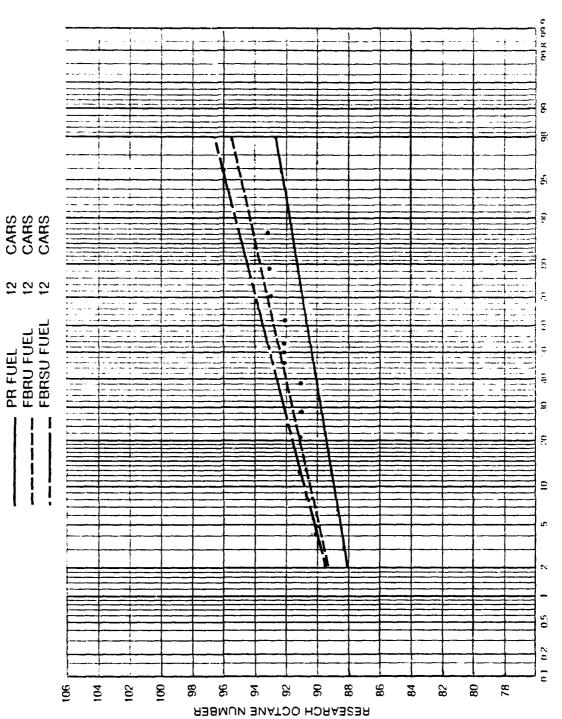
RESEARCH OCTANE NUMBER

PERCENT SATISFIED

FIGURE 13

DISTRIBUTION OF

MAXIMUM RESEARCH OCTANE NUMBER REQUIREMENTS
1980 MODEL NIJ 244



PERCENT SATISFIED

MAXIMUM RESEARCH OCTANE NUMBER REQUIREMENTS 1980 MODEL OCA 242/MCA 242 **DISTRIBUTION OF** FIGURE 14

PR FUEL FBRU FUEL

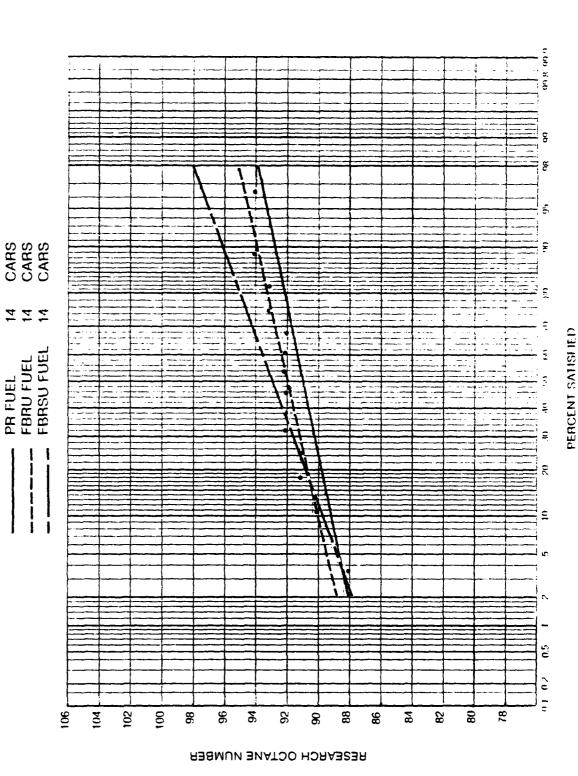
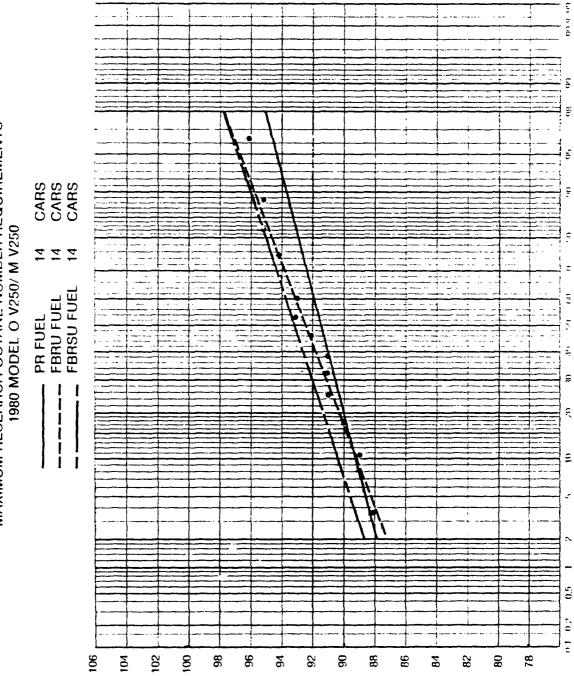


FIGURE 15

DISTRIBUTION OF MAXIMUM RESEARCH OCTANE NUMBER REQUIREMENTS 1980 MODEL O V250/ M V250



PERCENT SATISFIED

RESERRCH OCTANE NUMBER

MAXIMUM RESEARCH OCTANE NUMBER REQUIREMENTS
1980 MODEL PC 137/KC 137/ DC 137

PR FUEL 15 CARS

FBRU FUEL 15 CARS

RESEARCH OCTANE NUMBER

FIGURE 16

PERCENT SATISFIED

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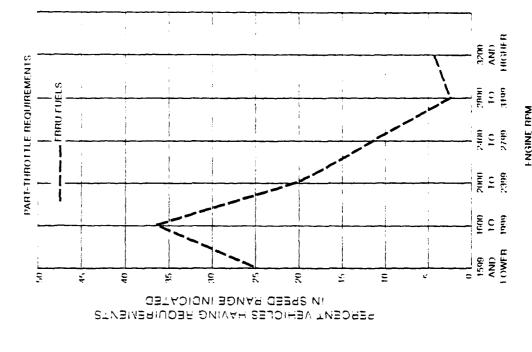
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FIGURE 17

ENGINE SPEEDS FOR MAXIMUM AND PART-THROTTLE OCTANE
NUMBER REQUIREMENTS
1980 U.S. AND IMPORTED VEHICLES



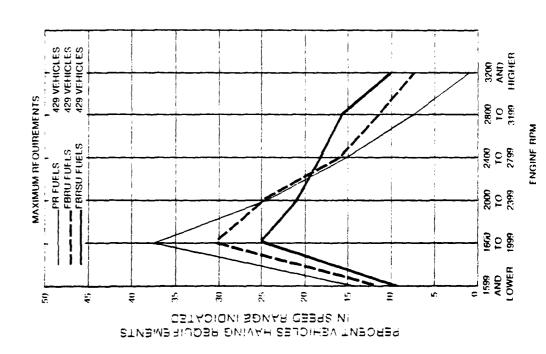
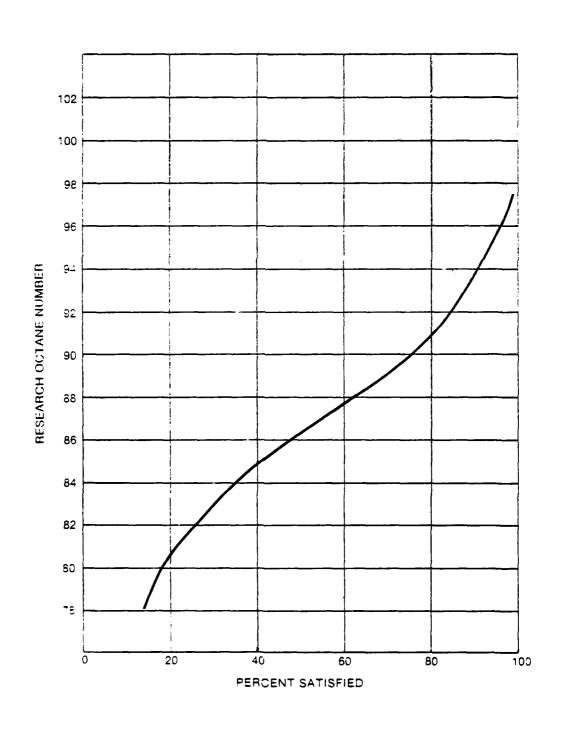


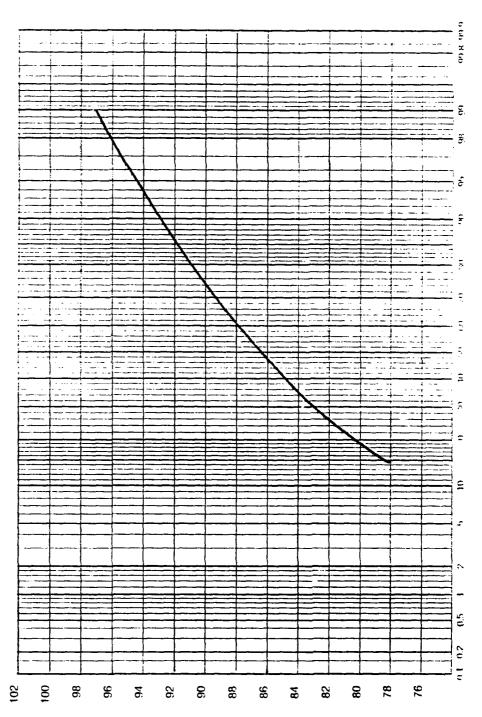
FIGURE 18a

DISTRIBUTION OF PART-THROTTLE FBRU
RON REQUIREMENTS
1980 U.S. AND IMPORTED VEHICLES
(389 VEHICLES)



THAME 1816

DISTRIBUTION OF PART-THROTTLE FBRU RON REQUIREMENTS 1980 U.S. AND IMPORTED VEHICLES (389 VEHICLES)



PERCENT SATISFIED

FIGURE 19a

DISTRIBUTION OF PART-THROTTLE FBRU
RON REQUIREMENTS
1980 U.S. VEHICLES
(312 VEHICLES)

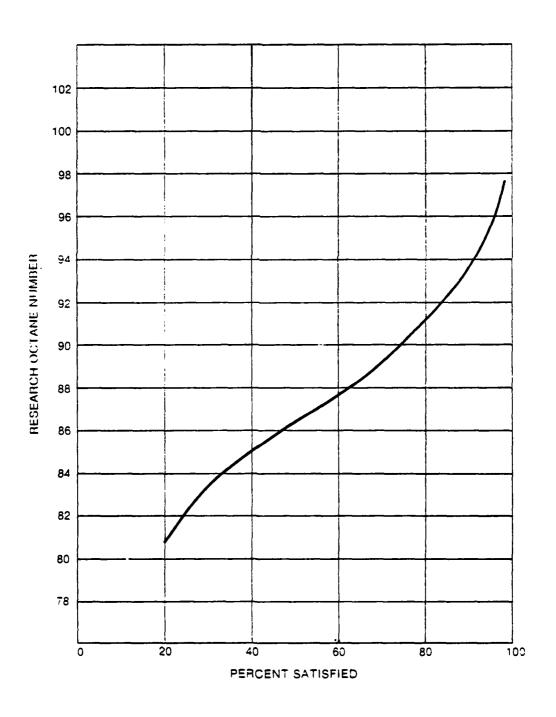
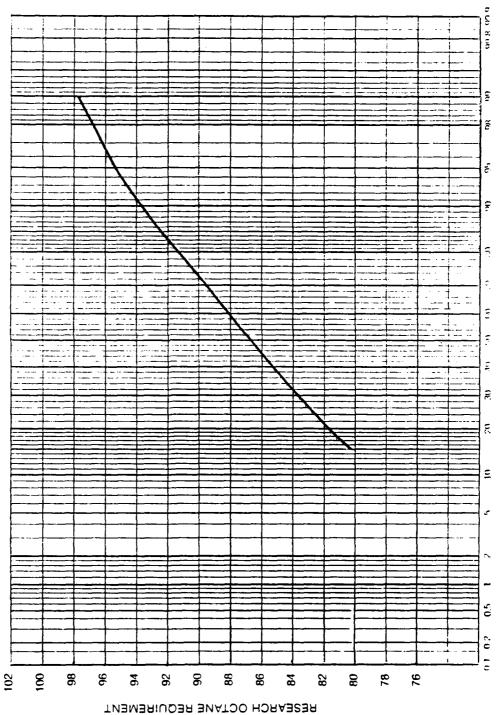


FIGURE 1915
DISTRIBUTION OF
PART-THROTTLE FBRU RON REQUIREMENTS
1980 U.S. VEHICLES
(312 VEHICLES)



PERCENT SATISFIED

FIGURE 20a

DISTRIBUTION OF PART-THROTTLE FBRU RON REQUIREMENTS 1980 IMPORTED VEHICLES (77 VEHICLES)

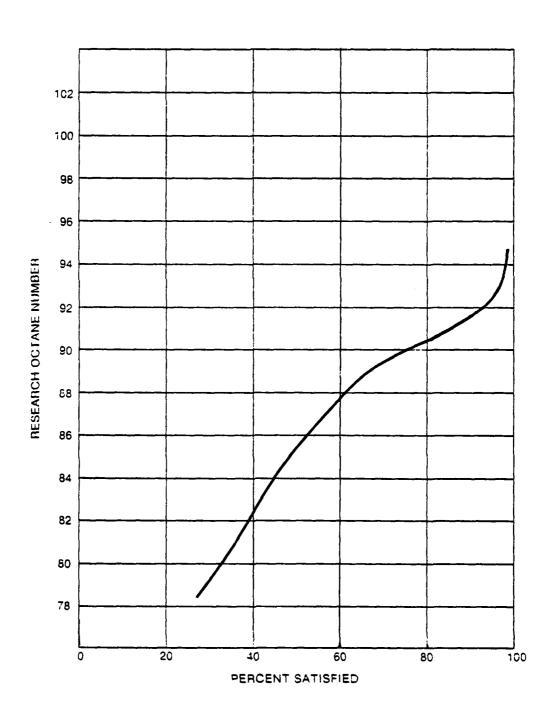


FIGURE 20b

DISTRIBUTION OF

PART-THROTTLE FBRU RON REQUIREMENTS
1980 IMPORTED VEHICLES
(77 VEHICLES)

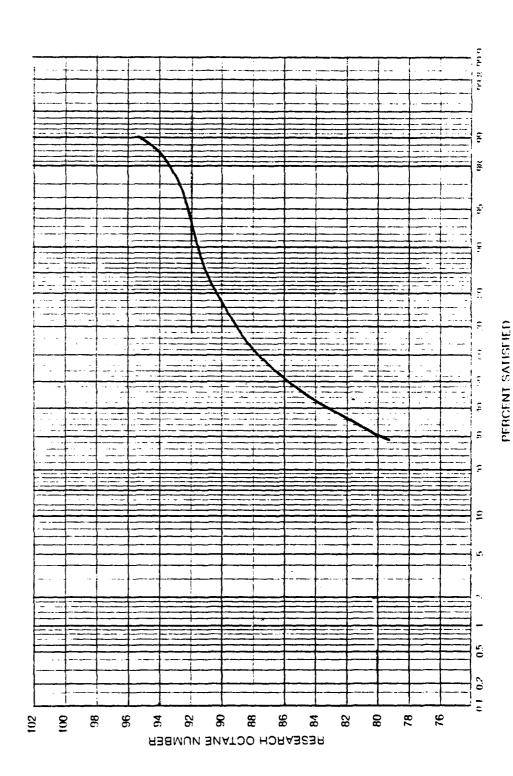


FIGURE 21

COMPARISON OF MAXIMUM FBRU RON REQUIREMENTS
WITH PART-THROTTLE REQUIREMENTS

1980 U.S. AND IMPORTED VEHICLES (429 VEHICLES)



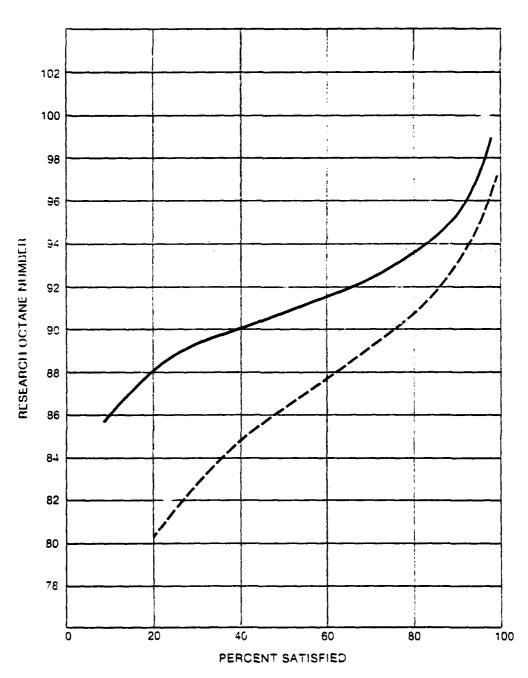


FIGURE 22

COMPARISON OF PART-THROTTLE FBRU RON REQUIREMENTS 1980 AND 1979 U.S. AND IMPORTED VEHICLES

______ 1980 SURVEY 389 VEHICLES _____ 1979 SURVEY 453 VEHICLES

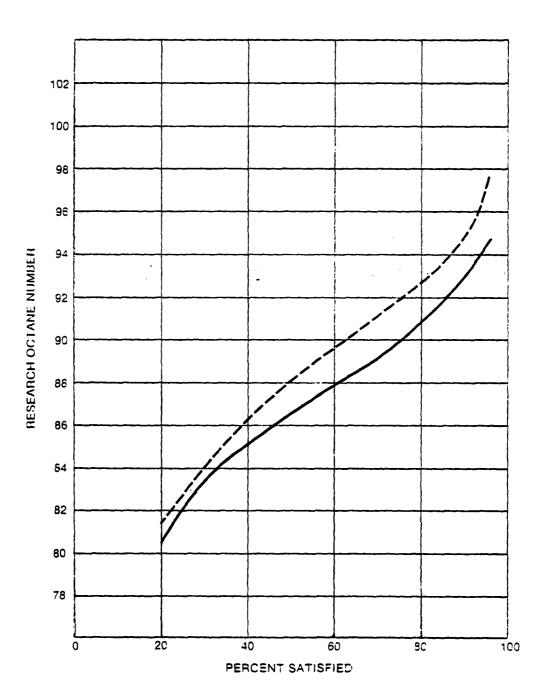
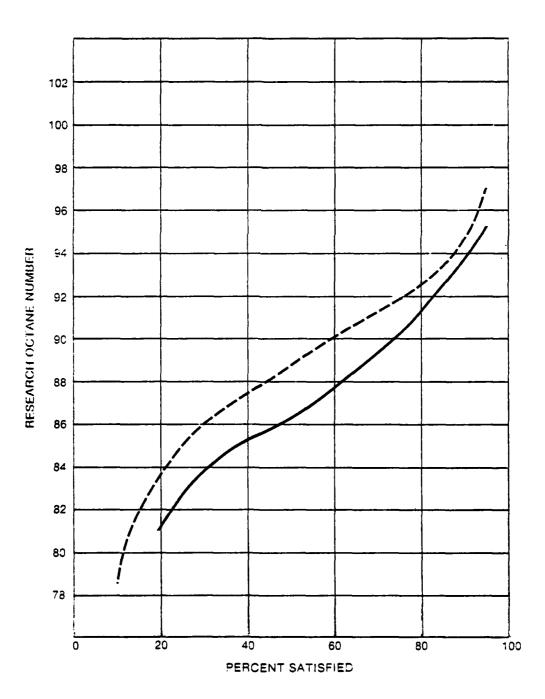


FIGURE 23

COMPARISON OF PART-THROTTLE FBRU RON REQUIREMENTS 1980 AND 1979 U.S. VEHICLES

1980 SURVEY: 312 VEHICLES
1979 SURVEY: 398 VEHICLES



APPENDIX A

PARTICIPATING LABORATORIES

PARTICIPATING LABORATORIES

EASTERN AREA

E. I. Du Pont de Nemours and Company, Inc. Wilmington, Delaware

Exxon Research and Engineering Company Linden, New Jersey

Gulf Research and Development Company Pittsburgh, Pennsylvania

Mobil Research and Development Corporation Paulsboro, New Jersey

Sun Company Marcus Hook, Pennsylvania

Texaco Inc. Beacon, New York

EAST CENTRAL AREA

Ethyl Corporation Detroit, Michigan

Ford Motor Company Dearborn, Michigan

General Motors Corporation Warren, Michigan

Standard Oil Company (Ohio) Cleveland, Ohio

WESTERN AREA

Chevron Research Company Richmond, California

Union Oil Company of California Brea, California

WEST CENTRAL AREA

Amoco Oil Company Naperville, Illinois

Atlantic Richfield Company Harvey, Illinois

Phillips Petroleum Company Bartlesville, Oklahoma

Shell Development Company Houston, Texas

Universal Oil Products Des Plaines, Illinois A P P E N D I X B

MEMBERSHIP: 1980 ANALYSIS PANEL

1980 CRC OCTANE NUMBER REQUIREMENT SURVEY

(CRC Project No. CM-123-80)

1980 Analysis Panel

D. P. Barnard, Leader Standard Oil Company (Ohio)

J. L. Borzone Mobil Research and Development Corporation

W. J. Brown Ethyl Corporation

E. S. Corner Consultant

N. D. Esau Amoco Oil Company

D. W. Hall Chevron Research Company

J. D. Rogers, Jr. E. I. Du Pont de Nemours and Company, Inc.

K. R. Schaper Gulf Research and Development Company

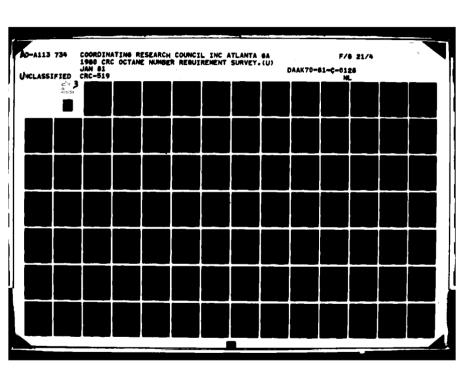
A. G. Swavely Ashland Oil, Inc.

R. A. Wirth Sun Company

T. Wusz Union Oil Company of California

APPENDIX C

PROGRAM



PROGRAM

for the

1980 CRC OCTANE REQUIREMENT SURVEY

CRC Project No. CM-123-80

Revised

March, 1980

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ATTACHMENT 2 - Technique for Determination of Octane Number Requirements of Light Duty Vehicles

I. INTRODUCTION

The 1980 program of the CRC-Motor Octane Number Requirement Survey Group will consist of a survey of the octane number requirements of 1980 model domestic and imported vehicles. For the purposes of this program, the designation "passenger vehicles" will include passenger cars and light-duty (<8500 lb/3856 kg GVW) pickup trucks, and vans. Approximately 450 vehicles will be tested. Most of these vehicles will be sampled in proportion to their relative production or import volume, to provide data from which to estimate the distribution of octane number requirements for the 1980 model vehicle population in the United States. In addition, select models of special interest will be tested in sufficient numbers to estimate their requirement distributions.

Knocking characteristics will be investigated with three series of reference fuels. Tank fuel knock will also be evaluated. Maximum octane requirements, regardless of throttle opening, will be established for each vehicle using high sensitivity unleaded full-boiling range reference (FBRSU) fuels, average sensitivity unleaded full-boiling range reference (FBRU) fuels and primary reference (PR) fuels. The sensitivity of the FBRU series is similar to average unleaded commercial fuels currently marketed.

Maximum part-throttle octane requirements will be completely defined with FBRU reference fuels.

Octane requirements throughout the speed range will be obtained with PR fuels only. After-run characteristics will be observed on tank fuel.

II. GEOGRAPHICAL AREAS

As in previous years, the 1980 survey will be conducted on a nationwide basis. The country has been divided into four geographical areas. Participants located in New York, New Jersey, Delaware and Pennsylvania have been included in the Eastern area; those located in Ohio, Michigan and Kentucky comprise the East Central area; those in Illinois, Texas and Oklahoma comprise the West Central area; and California participants make up the Western area. A coordinator has been appointed for each area as follows:

Eastern Area - S. Antika
East Central Area - D. P. Barnard
West Central Area - L. J. Olejnik
Western Area - T. Wusz

The area coordinators will contact their area participants periodically regarding the progress of the survey. To expedite this, it is suggested that participants send copies of all correspondence concerning the survey to the area coordinators. This program outlines the survey in broad terms. If more detailed information is desired, it is suggested that the participant contact his area coordinator.

III. VEHICLES

A total of approximately 450 vehicles will be tested in the 1980 Survey. By requesting each participating laboratory to test 25 vehicles and assuming 18 participants, the 450-vehicle total is obtained. These will be divided into two groups: (1) the statistical group, sampled in proportion to U.S. car model production or import volume, and (2) select models of special interest. Approximately 20 of each of these select models will be tested to provide an estimate of the octane requirement distribution for each model. Some of these 20 vehicles will be those already included in the statistical group and the remainder will be additional vehicles added to the program.

The desired number of vehicles to be tested in each category is as follows:

Statistical group Additional select	400
model group	50
Total	450

A detailed breakdown of the specific models and the number of each model to be tested will be circulated to the participants in May, 1980, after an estimate of vehicle model production has been obtained. If a participant wishes to begin work before that date, he can test select models with certainty that at least one of each model will be assigned to him. Design specifications for select models to be tested in the 1980 Survey are shown below. Selection of these vehicles has been based on new or modified design characteristics that might have a significant effect on octane number requirements and high sales volume which allows individual treatment without additional testing.

Model	Displ.	No.		Comp. Ratio		Trans. Type	
Oldsmobile	307(5.0)	V-8	4	7.9	150	Automatic	
Chevrolet	229 (3.8)	V-6	2	8.6	115	Automatic	
Pontiac	151(2.5)	L-4	2	8.2	86	Automatic	
Chevrolet	173(2.8)	V-6	2	8.5	115	Automatic	
Ford/Mercury	302(5.0)	V-8	2	8.4	134	Automatic FI	QC
Lincoln/TBird							
Fairmont/Zephyr	255(4.2)	V- 8	2	8.8	119	Automatic	
Volare/Aspen/	225(3.7)	L-6	1	8.4	90	Automatic	
Cordoba/Diplomat/M	irada						
Cord/Volare/Aspen (FED)		V-8	2	8.5	120	Automatic	

Wherever possible, specific vehicle assignments to individual participating laboratories will be made in a pattern which tends to minimize data bias. This will be accomplished by apportioning cars of a given model among the four geographical treas, and subsequently among the laboratories within each area, order to minimize the effect of non-random factors on the sults of the survey.

IV. FUELS

A. Full-Boiling Range Reference Fuels

Two full-boiling range reference fuel series will be used to define the vehicle octane number requirements. The two series will be unleaded and of varying sensitivity. One series will be comparable to the average sensitivity of unleaded commercial fuels (FBRU); the other series (FBRSU) will be about two numbers higher in sensitivity than the FBRU fuels. The Research Octane Number (RON) range for both fuel series is 77 to 101.

The two series will be blended in increments of two RON up to 84 and one RON above 84 from three base fuels for each series. The base fuels are compounded from normal refinery gasoline components. Limiting specifications for each base fuel for both series are shown in Table I.

Research and Motor ratings will be determined for incremental blends of each fuel series by all participants to provide data for establishment of blending curves. The average ratings and blending curves will be circulated to all participants.

B. Primary Reference Fuels

Blends of ASTM-grade isooctane and normal heptane will be prepared in two octane number increments from 76 to 82 and one octane number increments from 82 to 100.

C. Tank Gasoline

Research and Motor octane ratings will be obtained only on gasoline samples from the tank of vehicles with owner questionnaire (Attachment 1). Owners' questionnaire should be deleted when,

- a. the vehicle does not have a regular driver
- b. the ignition timing had to be reset.

V. TEST TECHNIQUE

All tests are to be conducted using the technique entitled, "Technique for Determination of Octane Number Requirements of Light Duty Vehicles" (CRC Designation E-15-80). A copy of this technique is included as Attachment 2 to this program. Octane number requirement investigations are to be conducted in all vehicles under level road conditions. Any vehicle obviously in poor mechanical condition or with malfunctioning emission control devices should not be considered for test work. The vehicles should have a minimum of 6000 deposit miles (9656 km) and preferably be privately owned and operated. Vehicles previously used for road octane rating must not be employed in this survey.

Data should be reported on each vehicle tested even though knock was not encountered on any of the fuels.

The order in which the fuels are to be tested is as follows:

1. Tank fuel, 2. FBRSU, 3. FBRU, 4. PR.

VI. DATA FORMS

The test results on each vehicle will be reported on data form (DFMF-11-1180) and work form (DFMF-12-1180). Copies of these forms will be mailed to all participants from the CRC office with instructions for their use printed on the forms. Additional instructions are included in each test technique.

VII. REPORTING RESULTS

A consolidated data report form (DFMF-15-1180) and speed range summary form (DFMF-25-1180) will also be provided by CRC. The consolidated report forms and standard data forms for each vehicle tested should be submitted to the Coordinating Research Council, Inc., 219 Perimeter Center Parkway, Atlanta, Georgia 30346, as soon as possible but not later than October 31, 1980.

TABLE I

PROPOSED LIMITING SPECIFICATIONS FOR 1980 FULL-BOILING RANGE REFERENCE FUELS*

Inspection Tests	Unleaded Average Sensi RMFD 326	Sensitivity Reference Puels (FBRU) RMED 327 RMED 328	Fuels (FBRU)	Unleaded High	Sensitivity Re RMFD 330	Unleaded High Sensitivity Reference Fuel (FRRSU) RMFD 329 RMFD 330 RMFD 331
ASTM Distillation, °F(°C)	(2,02)	06	c	G	G	S
10% Evap.	(46.1-70.	115-158	115-158	115-158	115-158	115-158
30% Evap.	150-190 (65.6-87.8)	150-190	150-190	150-190	150-190	150-190
50% Evap.	195-250 (90.6-121.1)	195-250	195-250	195-250	195-250	195-250
70% Evap.	(110.0-1)	230-300	230-300	230-300	230-300	230-300
90% Evap.	285-374 (140.6-190.0)	285-374	285-374	285-374	285-374	285-374
End Point, Max.	437 (225)	437	437	437	437	437
RVP, psi (KPa)	7-9 (48-62)	7-9	6-1	6-1	7-9	7-9
Lead, g/gal (g/l)		<0.03	<0.03	<0.03	<0.03	<0.03
Oxidation Stability, minutes, minimum	1440	1440	1440	1440	1440	1440
<pre>Hydrocarbon Type, Vol \$ Aromatics** Olefins Saturates</pre>	To be determined by in	by inspection and reported	x ted			
Octane Number						
Research Sensitivity***	77±1 4±.5	90±1 7.7±.5	101±1 11±.5	77±1 6.0±.5	90±1 9.7±.5	101±1 13±.5
Color	Clear	Green	Red	Yellow	Deep Purple	Light Blue

All fuels to contain minimum 5 PTB of a 100% active anticxidant. No manganese added.

* To be compounded from normal refinery components

** Is maximum Benzene or legal

*** Sensitivites are shown for the mean Research Octane Number.

Minimum of two units sensitivity difference between corresponding fuels of each series.

OWNER'S QUESTIONNAIRE

CRC OCTANE NUMBER REQUIREMENT SURVEY

OWNER:

Your vehicle is being tested for fuel octane number requirements by a Coordinating Research Council activity. To help analyze the data, we would like the person who has recently been driving the vehicle to answer the following questions:

.
1. Has any engine knock (ping) been encountered recently?
Yes Occasionally
No Frequently
2. If "Yes" was it during any of these conditions?
Low Speed Hill Climbing Normal Acceleration
High Speed Towing Trailer Maximum Acceleration
3. Did you consider the knock (ping) objectionable?
Yes No
4. Did the knock (ping) occur on the fuel that is now in the tank?
Yes No
5. Does the engine continue to run after the key is turned off?
Yes No
6. If "Yes," did you consider the engine running with the key off objectionable?
Yes No
Vehicle MakeLicense No
Vehcile Identification No.

- interpretation

TECHNIQUE FOR DETERMINATION
OF OCTANE NUMBER REQUIREMENTS
OF LIGHT DUTY VEHICLES

(CRC Designation E-15-80)

Revised

February, 1980

TECHNIQUE FOR DETERMINATION OF OCTANE NUMBER REQUIREMENTS OF LIGHT DUTY VEHICLES

(CRC Designation E-15-80)

A. GENERAL

The technique provides for the determination of octane number requirements of a vehicle in terms of borderline spark knock and surface ignition knock, regardless of throttle position, on two series of full-boiling range reference fuels as well as on primary reference fuels. It also provides octane requirements throughout the speed range on primary reference fuels.

Spark knock, surface ignition and after-run characteristics of tank fuel will also be determined.

B. DEFINITION OF TERMS

- 1. The following definitions of knock were approved by the CFR and CLR Committees on June 8, 1954, and will be used in this technique. Knock is the noise associated with autoignition* of a portion of the fuel-air mixture ahead of the advancing flame front. The flame front is presupposed to be moving at normal velocity. With this definition the source of the normal flame front is immaterial it may be the result of surface ignition or spark ignition.
 - a. Spark Knock: A knock which is recurrent and repeatable in terms of audibility. It is controllable by the spark advance; advancing the spark increases the knock intensity and retarding the spark reduces the intensity. This definition does not include surface ignition knock.
 - b. Surface Ignition Knock: Knock which has been preceded by a surface ignition. It is not controllable by spark advance.** It may or may not be recurrent and repeatable.

^{*} Autoignition: The spontaneous ignition and the resulting very rapid reaction of a portion or all of the fuel-air mixture. The flame speed is many, many times greater than that which follows normal spark ignition. There is no time reference for autoignition.

^{**} For the purpose of this program, it is not intended that surface ignition knock be identified by manipulation of the spark advance.

- 2. The following definitions of knock intensity were specifically adopted for use in this technique:
 - a. No Knock: This means no spark knock or surface ignition knock.
 - b. Borderline Knock: This means spark knock of lowest audible intensity, recurrent surface ignition knock of borderline intensity, or infrequent (three or less) surface ignition knocks regardless of intensity.
 - c. Above Borderline Knock: This means greater than borderline spark knock, recurrent surface ignition knock greater than borderline intensity, or frequent (four or more) surface ignition knocks regardless of intensity.
 - d. After-Run: The engine continues to operate after the ignition is turned off.

3. Definition of Accelerations

Accelerations are made at maximum-throttle and partthrottle conditions which are defined below:

- a. Maximum-Throttle: The throttle is depressed and regulated throughout the acceleration to maintain the critical maximum throttle position. Maximum throttle will constitute the throttle position from detent to 2 inches Hg (6.7 KPa) above detent manifold vacuum. (This could be in highest gear or passing gear for automatic transmissions.) The detent manifold vacuum obtainable on a given model is determined by the transmission characteristics.
- b. Part-Throttle: The throttle is depressed and regulated throughout the acceleration to maintain a desired, constant critical manifold vacuum. Part-throttle will constitute the throttle position from 2 inches Hg (6.7 KPa) above detent vacuum up to the highest road load vacuum. For vehicles with converter clutch transmissions, part-throttle will constitute the throttle position from 1 inch Hg (3.4 KPa) above the minimum vacuum for converter clutch application up to the highest road load vacuum.

C. VEHICLE PREPARATION

The following vehicle preparation steps should be completed before any octane tests are run. Detailed procedures for each adjustment can be found in the manufacturers' shop manuals.

1. Record vehicle identification number and emission control type, Federal, Altitude or California. Fill in heading on data sheet DFMF-11-1180. Ford emission calibration numbers are to be recorded.

- Inspect all vacuum lines and air pump hoses for appropriate connections. Also, check to see if PCV valve, distributor vacuum delay valve, EGR valve and heated inlet air mechanism are functioning. Engine must be warmed up for these checks.
- 3. Record engine idle speed and observe anti-dieseling solenoid operation. Adjust to manufacturers' recommended specifications as specified on the under-hood decal.
- 4. Observe and record basic spark timing at recommended engine speed. Adjust to manufacturers' recommended setting as specified on the under-hood decal.
- 5. Crankcase oil, radiator coolant, automatic transmission fluid, and battery fluid levels shall be maintained as recommended by the manufacturer.
- 6. A calibrated tachometer graduated in 100 rpm (or smaller) increments and capable of indicating engine speed from 0-5000 rpm shall be installed on each vehicle.
- 7. One calibrated vacuum gage, graduated in one-half inch of mercury (or smaller) increments and capable of indicating vacuum from 0-24 inches of mercury (0-81 KPa) shall be connected to the intake manifold.
- 8. An auxiliary fuel system shall be provided to supply test fuels to the engine. Caution shall be taken to avoid placing auxiliary fuel lines in locations which promote vapor lock. If vehicles with carbureted engines have tank return fuel lines, this return line should be blocked off. Disconnect line from fuel tank to evaporation control system canister. Instructions for fuel handling with fuel injection systems is shown in the Appendix.
- 9. For vehicles with owner questionnaire completed, a sample of the tank gasoline shall be withdrawn for determination of Research and Motor method octane number ratings.

D. TEST PROCEDURE

1. Engine Warm-Up

- a. To stabilize engine temperatures, a minimum of ten miles of warm-up is required. The test vehicle should be operated at 55 mph (88 kph) in top gear with a minimum of full-throttle operation.
- b. During the warm-up period, the general mechanical condition of the vehicle should be checked to insure satisfactory and safe operation during test work.

2. Fuel Change-Over

Caution: Because of the installation of catalytic devices on these vehicles, permanent damage may result if the engine runs lean or stalls. Therefore, change-over from one fuel to another must be accomplished without running the carburetor or fuel injection system dry. Fuel handling procedures for vehicles equipped with fuel injection systems are explained in the Appendix.

To eliminate contamination of the new fuel with residual amounts of the previous fuel, flush system twice with new fuel.

After fuel change-over, make one maximum-throttle acceleration before beginning Vehicle Rating Procedure.

3. Details of Observations

a. Operating Conditions

All octane number requirements will be determined under level road acceleration conditions. Vehicles with manual transmission should not be tested in overdrive gear. Vehicles equipped with free wheeling or overdrive units shall be tested with this unit (free wheeling or overdrive) locked out of operation. Automatic transmissions shall be run in "Drive". Test accelerations will be made as described below under 3d in highest drive gear.

Tests will be conducted on moderately dry days preferably at ambient temperatures above 60°F (15.5°C). Tests should not be conducted during periods of high humidity such as prevail when rain is threatening or during or immediately after a rain storm. Laboratories with control capabilities should target for 70°F (21°C) air temperature and 50 grains of water per pound (7.14 gm/kg) of dry air whenever possible.

Air conditioned vehicles will be tested with air conditioner turned ON. (Normal setting, low fan.)

b. Order of Fuel Testing

1. Tank

3. FBRU

2. FBRSU

4. Primary

c. Determination of Knock Intensity

Octane requirements will be established by evaluating the occurrence of knock in terms of knock intensity: "N" for none, "B" for borderline, and "A" for above borderline. Establishment of representative knock intensity for a given fuel will be accomplished with the fewest number of accelerations possible. As defined below, the first two duplicating accelerations are sufficient with "N" and "B" knock intensity.

Number	of Accele	rations	Representative Rating
<u>1</u>	2	<u>3</u>	
N	N	-	N
N	В	N	N
N	В	В	В
В	N	В	В
В	В	-	В
В	A	-	A
A	-	-	A

All subsequent accelerations will normally be discontinued when "A" knock intensity is experienced and testing continued with a higher octane number fuel in that series. An exception will be made if "A" knock is experienced on the highest octane fuel which knocks in the engine. In this case, it may be necessary to run additional accelerations to determine the speed of maximum knock intensity. If "A" knock is experienced at initiation of acceleration, as limited by transmission characteristics, this speed will be considered the speed of maximum knock. Otherwise, the midpoint between knock-in and knock-out will be considered the speed of maximum knock. When establishing knock-in and knock-out, back off on the throttle between points to eliminate "A" knock. Tip-in knock should be ignored.

d. Determination of Maximum Octane Requirement

Tests should be run to 60 mph (97 kph) unless required to terminate at 55 mph (88 kph) because of legal speed limits.

1. Vehicle Operating Procedure (for driver)

- a. For establishment of transmission characteristics, obtain top gear downshift engine rpm and manifold vacuum at 25, 35, 45 and 55 mph (40, 56, 72, 88 kph) by movement of the throttle through the detent position. Record both engine rpm and manifold vacuum at the downshift point for each speed. The vehicle brakes may be applied lightly if necessary to maintain vehicle speed. In addition, for transmissions with converter clutches determine the minimum vacuum and minimum road speed for converter clutch application. Record on data sheet.
- b. For maximum throttle requirements in highest gear accelerate at the critical maximum throttle position from the minimum obtainable speed as determined in (a)* up to 60 mph (97 kph). To obtain critical maximum throttle position, move the throttle from detent to 2 inches Hg (6.7 KPa) vacuum above detent while accelerating. For vehicles with converter clutch transmissions perform this acceleration with the converter clutch applied and released. Find the throttle position for the maximum knock intensity. If transmission downshifts abort and start acceleration again.

Starting speed for accelerations on manual transmission vehicles should be the lowest speed from which the vehicle will accelerate smoothly.

- c. For maximum throttle requirements in passing gear for vehicles with automatic transmissions, accelerate from 10 mph (16 kph) below the starting speed for highest gear acceleration up to 60 mph (97 kph). When available, set shift gear selector to passing gear.
- d. For those vehicles with vacuum delay devices, to stabilize vacuum advance before starting each part-throttle acceleration, operate at road load for 40 seconds at the speed from which the acceleration is to begin.
- For part-throttle requirements, accelerate in highest gear at constant critical manifold vacuum from minimum obtainable speed to 60 mph (97 kph) or until vehicle ceases to accelerate. To obtain critical part-throttle vacuum, operate at road load for 40 seconds at 25, 35, 45, and 55 mph (40, 56, 72 and 88 kph). At each speed move the throttle from the highest road load vacuum, down to 2 inches Hg (6.7 KPa) above detent manifold vacuum (1 inch Hg (3.4 KPa) above the minimum vacuum for converter clutch in from 3 to 5 seconds. application) this range, find a manifold vacuum for maximum knock intensity to use as the critical vacuum for all subsequent part-throttle accelerations. The vehicle brakes may be applied lightly if necessary, to maintain vehicle speed.

f. Determination of After-Run Characteristics

Determination of the occurrence of after-run will be evaluated on tank fuel. Following the engine warm-up, moderately brake the vehicle to a stop (foot off throttle) and place automatic transmission vehicles in park position, manual transmission vehicles in neutral. Air conditioner must be left off. Immediately turn key to the "OFF" position. Note on the data sheet if afterrun occurs.

2. Vehicle Rating Procedure (for rater)

Knock rating should be performed while in a normal seated position (head above instrument panel) with floor mats in place.

- Step 1 Using an estimated non-knocking fuel in a given fuel series, investigate for incidence of knock under conditions as described in 3d (1) (b), and 3d (1) (c) above.
- Step 2 If no knock occurs, go to a lower octane number blend in that series and repeat Step 1.

- Step 3 If knock occurs at one or more of the operating conditions in Step 1, then continue investigation at the critical condition(s) with higher octane blends until highest octane fuel giving knock is determined within one octane number or one blend.

 Record maximum knock intensity on all fuels and speed of maximum knock intensity on highest octane fuel that knocks.
- Step 4 Using the lowest octane blend that did not
 knock in Step 3, investigate for incidence
 of part-throttle knock as described in 3d
 (1) (e).
- Step 5 If no knock occurs with FBRU Fuel, investigate for knock with lower octane fuels until maximum part-throttle requirement is defined down to the limit of the lowest octane fuel available. If no knock occurs with PRF and FBRSU fuels, further investigations are not required with these fuels at part-throttle.

The rating procedure is given in arrow diagram form on page 16.

e. Tank Fuel Observations on Vehicles with Owner's Questionnaire

Investigate for maximum-throttle and part-throttle knock as detailed in Item 3d (1). Define maximum knock intensity as per Item 3c. Record maximum knock intensity, speed of maximum knock intensity and manifold vacuum at each operating condition. Determine after-run characteristics as described in Item 3d (1) (f).

f. Octane Number Requirement Over Speed Range

Octane requirements over the speed range will be obtained on primary reference fuels only using throttle position for maximum requirements. These will be established by recording the knock-in and knock-out points during maximum requirement acceleration with each incremental fuel investigated. It may be necessary to test one or two additional lower octane fuels to describe the knocking characteristics over the speed range. Accelerate at maximum throttle from minimum obtainable speed as determined in 3d (1) (a) up to 3500 rpm if necessary in order to define requirements. These should be run to 60 mph (97 kph) unless required to terminate at 55 mph (88 kph) because of legal speed limits. If 3500 rpm cannot be attained in top gear, accelerations shall be discontinued and resumed in the next highest gear from 500 rpm below the engine speed at which top gear accelerations were determined.

When "A" knock is experienced, continue the acceleration but back off on the throttle to maintain "B" knock until just prior to the knock-out point.

E. INTERPRETATION OF DATA

The data will be recorded on data sheet (DFMF-11-1180). Maximum octane requirements for all reference fuels shall be determined as follows:

- If the knock intensity of the highest fuel giving knock is borderline, the requirement shall be reported as the octane number of that fuel.
- If the knock intensity of the highest fuel giving knock is above borderline, the requirement shall be reported as onehalf the difference between the fuel giving knock and the next highest fuel.

Speed range data shall be reported on data sheet (DFMF-11-1180) as the engine speed of knock-in and knock-out for the octane number of the primary reference fuel tested.

When transferring data to the summary report form, record "no" data as well as "yes" data.

Record data on all fuels tested, even though knock was not encountered. When transferring data to the summary report form (DFMF-15-1180), record results on all fuel series for each throttle condition investigated. Use proper letter designation (see footnotes on summary sheet) to designate requirements outside of the reference fuel limits.

Requirements for the various engine speeds will be determined by fitting a smooth curve through the knock-in and knock-out points on work form (DFMF-12-1180). Primary reference fuel requirements at various engine speeds should be reported to the nearest one-half octane number and recorded on the speed range summary sheets (DFMF-25-1180).

It is important that the vehicle identification number (VIN) of each vehicle tested be recorded on all data and summary sheets to provide a means of cross-indexing.

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APPENDIX CRC E-15-80

PROCEDURE FOR SETTING UP VEHICLES AND HANDLING REFERENCE FUELS ON VEHICLES EQUIPPED WITH FUEL INJECTION

- 1. To run octane requirements on fuel injected vehicles it is necessary to run an external fuel line to the inlet of the vehicle fuel injection pump.
- 2. The fuel return line from the engine to the fuel tank must be disconnected after the fuel pressure regulator (in engine compartment) and before the fuel tank. An auxiliary line long enough to reach the cans must be added to the fuel return line.
- 3. Make certain that the fuel tank connections are plugged, this means both the normal fuel pump inlet line and the normal fuel return line connection. On vehicles with an in-tank booster pump, this pump must be shut off so it cannot run during the time the vehicle is operating on the external fuel system. If this pump is not disconnected, it will be destroyed.
- 4. An electric fuel pump (Bendix type acceptable) must be used to draw fuel from the reference fuel can to supply the fuel injection pump on the vehicle. Caution must be exercised to keep the fuel line between the reference fuel cans and the vehicle fuel injection pump full of fuel. If very much air gets into this line, the fuel injection system will become air bound and it is difficult to get the air out of the system.
- 5. Once the fuel injection pump line and return line have been disconnected, all subsequent operations must be done from an external fuel source.
- 6. It is possible to use three-way valves in the fuel line between the fuel pump and the fuel tank and between the return line and the fuel tank. When used, the operator must change the return line valve to the auxiliary fuel system while the engine is shut down, to avoid building up excessive pressure in the return line which could damage both the fuel pressure regulator and injection pump.
- 7. When changing from one reference fuel to another, the following steps must be followed:
 - a. Put fuel inlet line in reference fuel tank with the return line going to a slop fuel can. Do not keep fuel inlet line out of the fuel can any longer than is necessary to move it from one can to the next. DO NOT RUN OUT OF FUEL.

Attachment 2

- b. Observe the fuel stream in the fuel return line. As soon as a steady flow of fuel is observed, move the fuel return line to an empty one-quart can (0.946 1). Allow one quart (0.946 1) of fuel to flow into this can before inserting the return line into the chosen reference fuel can. This operation should take about 60 seconds.
- c. When going to the next reference fuel, it will be necessary to repeat Steps a and b.

The fuel injection pumps on most vehicles pump between 30 and 50 gallons (114-189 ℓ/h) of fuel per hour. Therefore, Steps a and b should be followed very closely or there will be gross reference fuel contamination or you will use a lot more reference fuel than is required to run each test. If Steps a and b are followed exactly you will be discarding to slop about two quarts (1.892 ℓ) of reference fuel each time you change reference fuels. The two quarts (1.892 ℓ) to slop will be at least as much fuel as is consumed to get the reference fuel rating.

APPENDIX D

DATA ON 1980 FULL-BOILING RANGE REFERENCE FUELS

TABLE D-I

1980 UNLEADED AVERAGE SENSITIVITY FULL-BOILING RANGE REFERENCE FUEL SERIES (FBRU)

		ing Data Compos Volume Percent	sition,	
Research Octane No.	RMFD-326-80	RMFD-327-80	RMFD-328-80	Motor Octane No.
78 80 82 84 85 86	96 81 65 49 40 32 24	4 19 35 51 60 68 76		74.5 75.9 77.5 78.9 79.7 80.4 81.0
88 89 90 91 92 93	15 7	85 93 98 89 81 72 63	2 11 19 28 37	81.7 82.3 83.0 83.6 84.2 84.8 85.5
95 96 97 98 99 100 101 (100.7)		54 45 36 26 17 7	46 55 64 74 83 93	86.1 86.7 87.3 88.1 88.8 89.6 90.3

TABLE D-II

1980 UNLEADED HIGH SENSITIVITY FULL-BOILING RANGE

REFERENCE FUEL SERIES (FBRSU)

Blending Data Composition, Volume Percent Research Motor RMFD-331-80 Octane No. RMFD-329-80 RMFD-330-80 Octane No. 72.5 38 74.1 75.6 58 65 72 77.0 77.7 87 78.4 79.0 89 86 79.6 7 80.1 91 80.6 81.2 81.8 82.4 83.0 83.5 41 29 84.1 84.7 85.4 6 86.3 87.3 101 (100.5) 87.9

TABLE D-III

SENSITIVITIES OF 1980 FULL-BOILING RANGE REFERENCE FUELS

RON	<u>FBRU</u>	FBRSU
78 80 82 84 85 86	3.5 4.1 4.5 5.1 5.3 5.6 6.0	5.5 5.9 6.4 7.0 7.3 7.6 8.0
88 89 90 91 92 93 94	6.3 6.7 7.0 7.4 7.8 8.2 8.5	8.4 8.9 9.4 9.8 10.2 10.6 11.0
95 96 97 98 99 100	8.9 9.3 9.7 9.9 10.2 10.4 (10.4)	11.5 11.9 12.3 12.6 12.7 12.7 (12.6)

TABLE D-IV

COMPARISON OF 1979 AND 1980 FUEL SENSITIVITIES

5		FBI	RU	·	FBRS	SU
Research Octane No.	<u>1980</u>	<u>1979</u>	Difference	1980	<u>1979</u>	Difference
78 80 82 84 85 86 87	3.5 4.1 4.5 5.1 5.3 5.6 6.0	3.8 4.4 5.0 5.7 6.2 6.4 7.0	-0.3 -0.5 -0.6 -0.9 -0.8 -1.0	5.5 5.9 6.4 7.0 7.3 7.6 8.0	5.4 6.3 6.8 7.4 7.6 8.0 8.4	0.1 -0.4 -0.4 -0.4 -0.3 -0.4
88 89 90 91 92 93 94	6.3 6.7 7.0 7.4 7.8 8.2 8.5	7.4 7.9 8.3 8.8 9.2 9.6 9.8	-0.9 -1.2 -1.3 -1.4 -1.4 -1.3	8.4 8.9 9.4 9.8 10.2 10.6 11.0	8.7 9.0 9.5 9.8 10.2 10.6 11.0	-0.3 -0.1 -0.1 0.0 0.0 0.0
95 96 97 98 99 100	8.9 9.3 9.7 9.9 10.2 10.4 10.4	10.2 10.4 10.6 10.9 11.0 11.2	-1.3 -1.1 -0.9 -1.0 -0.8 -0.8	11.5 11.9 12.3 12.6 12.7 12.7	11.2 11.6 11.7 11.9 11.9 12.0 12.2	0.3 0.6 0.7 0.8 0.7

TABLE D-V

FUEL INSPECTIONS

1980 UNLEADED AVERAGE SENSITIVITY REFERENCE FUELS (FBRU)

ASTM D-86	RMFD 326	RMFD 327	RMFD 328
Distillation, °F 1BP 10% Evap. 30% Evap. 50% Evap. 70% Evap. 90% Evap. End Point	106 138 182 219 243 318 404	106 138 164 202 256 344 436	114 156 198 238 257 296 360
Gravity, °API	66.6	60.6	51.2
RVP, psi	8.0	7.1	6.9
Lead, g/gal.	0.009	0.015	0.013
Oxidation Stability, hr.	>24	>24	>24
Hydrocarbon Type, Vol. %			
Aromatics Olefins Saturates	12.7 10.6 76.7	18.2 11.1 70.7	50.8 1.6 47.6
Research Octane Number	77.1	89.9	100.9
Motor Octane Number	73.1	82.1	90.0
Sensitivity	4.0	7.8	10.9
Color	Clear	Green	Red

TABLE D-V (Continued)

FUEL INSPECTIONS 1980 UNLEADED HIGH SENSITIVITY REFERENCE FUELS (FBRSU)

Aomi P. Os	RMFD 329	RMFD 330	RMFD 331
ASTM D-86			
Distillation, °F 1BP 10% Evap. 30% Evap. 50% Evap. 70% Evap. 90% Evap. End Point	100 146 203 262 308 388 420	90 124 159 214 248 353 430	104 152 204 240 257 294 398
Gravity, °API	53.1	63.5	46.2
RVP, psi	9.3	9.0	6.9
Lead, g/gal.	0.009	0.017	0.014
Oxidation Stability, hr.	>24	>24	>24
Hydrocarbon Type, Vol. %			
Aromatics Olefins Saturates	36.0 18.2 45.8	23.8 26.5 49.7	59.8 12.4 27.8
Research Octane Number	77.3	90.8	100.6
Motor Octane Number	71.2	80.9	87.7
Sensitivity	6.1	9.9	12.9
Color	Yellow	Purple	Blue

APPENDIX E

1980 OCTANE NUMBER REQUIREMENT SURVEY DATA

GLOSSARY

Emission Certification: California

Federa1

Both California and Altitude

Knock Sensor: Υ Yes

No

Transmission: Α Automatic

Manual

Air Conditioner: Yes

Spark Advance: Before Top Center

After Top Center

Test Fuel: Tank Fuel

2 **FBRSU FBRU**

PR

Gear: Drive, Automatic Transmissions

Passing Gear, Automatic Transmissions

1-5 Manual Transmissions

Octane Number Requirements: Less than lowest available O.N. for FBRU

(expressed as Research O.N.) and FBRSU fuels and less than 76 for PR fuels

Higher than highest available O.N. for FBRU and FBRSU fuels and higher than 100 O.N. for

PR fuels

Noise Type: Spark knock only

Surface ignition knock only

Both K and S

Tank Fuel

Owner Report

Yes Knock:

No

Yes Objectionable:

No

After-Run: Yes

No

Rater Report

Noise Intensity: N None

Borderline В

Above borderline

Throttle: If knock at maximum throttle

Manifold vacuum if knock at part-throttle

After-Run: Yes

No

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APPENDIX F

SPEED RANGE DATA

APPENDIX F

Primary Reference Fuel Speed Range Octane Number Requirement

Primary reference fuel octane number requirements were determined at one to eleven of the specified engine speeds on 337 vehicles (Table F-I). Speed range data were analyzed for the six select models, totaling 79 cars, and are plotted in Figures F.1 through F.6 for the mean (50% satisfaction level). For 21 cars in the select model category, the speed range data were either missing or insufficient for analysis. The select model calculated data are given in Table F-II.

FABLE F-1

	⊢ad:	32!					PRIMA	PRIMARY R.F.		M.		PEQUIR	PEQUIREMENTS.	. AT	Mda	
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192 24 HA F16	F A 9.2	Y + 5 + 3	26165	73 29.40	56 07					80.0	82.5	84.5	85.5	85.0	83.9	42.0
20 22 HA F16M	F M 3.2	Y = 3 = 3	5436	70 29,50	50 50	l	J	ب	76.5	77.0	77.5	78.0	79.5	79.0	77.5	74.9
134 29 AA F16M	F M A.?	N + 3 + 3	8552	48 30.24	55 52						ر	ب	ب			
154 44 HA FIRM	F M B.2	Y = 3 = 3	10535	69 29.54	54 63					89.0	88.5	86.5				
372 26 BA F16M	F M 8.2	y -15 + 3	18023	93 29.88	8A 12A			80.5	81.5	83.0	81.5	80.5	H0.5	80.0	80.0	
195 28 DC 137	F A 8.4	Y +12 +12	8102	84 29.28	28 142	85.5	98.0	96.0	83.5	82.0	81.5	81.0	80.5	90.0		
304 A 9C 137	F A 8.4	Y +12 +12	12773	80 30.02	99 20		94.0	92.5	87.5	86.0						
139 29 00 252	F A 9.5	Y +12 +12	15187	70 29.81	25 18		92.5	93.0	90.5	98.5	87.5	86.5	85.5	A5.0		
A 22 01 252	F A 8.5	Y +12 +12	14081	70 29.36	36 50		84.5	A8.0	86.5	85.5	84.5	83.5	93.0	R7.0		
654 0 4 94	F A 8.4	X +12 +12	6406	74 29.21	21 73			AA.0	89.5	0.00	89.5	84.5	9.0	A7.0	86.0	A5.5
22 22 66 460	F A 9.2	Y +16 +18	11916	70 29.40	40 50				86.5	87.0	84.5	83.0	H2.0			
097 95 7 07	F A 8.2	Y +21 +18	1074	81 29.34	34 46			87.0	86.5	85.5	84 • ባ	83.5	82.5	81.5	80.5	79.5
173 5 66 450	F A 8.2	Y +18 +19	6331	72 30.14	14 62				A5.0	84.0	86.0	85.0	A3.5	H2.0	د .	A0.0
369 26 66 460	F A 8.2	Y +19 +18	16534	107 29.9A	9R 11S			80.0	83.0	94·0	A3.0	82.0	79.5			
9 22 HLA 238	F A 8.0	¥ +13 +15	16580	70 29.27	15 22					89.5	88.0	R7.0	45.0	0.18	78.5	74.5
35 4 HLV 225	F A A.2	N +12 +12	5480	80 29.12	12 60			#A.T	89.5	40.0	90.0	0.68	AB.0	A7.0	A6.5	96.0
294 7 MLV 225	F A 8.2	Y +12 +12	1249	70 30.11	11 51					81.5	A3.5	45.5	A7.4	AG. 2	H4.5	ς r g
325 3 HLV 225	F A A.2	Y +12 +12	9874	74 29.87	87 75								99.0	9.3.0	A. A.	84.0
343 46 HLV 225	C A A.2	Y +12 +12	4199	16 29.50	50 70					95.0	0.0v	90.0	90.5	P. A. R.	2.18	A5.0
349 46 MLV 225	C A 8.2	Y +12 +12	3+10	77 29.2n	2n 74					94.0	A. A.	B7.0	A6.0	A5.0		
129 29 HLS 225	F A A.2	Y +10 +10	9424	70 29.69	69 KB					86.0	AB.0	47.5	86.5	A5.0	A4.0	и3.0

TABLE F-I (Continued)

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d I	75	70	A .	80	93	71 3	90	75	7.0	8	70	7.0	å	4	70	Я	70	74 2	68 2	A 5 8	72.3	7 0 7
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TABLE F-I (Continued)

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30.26 51 81.0 83.5 84.0 85.0 81.0 87.5 87.0	7.5 Y +20 +20 23167 9	29.75		96.0	86.5	83.0					
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44 R2.0 B6.0 B4.5 R3.0 R2.0 64 R3.0 </td <td>8.2 Y +12 +12 6145 70 2</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>ب</td> <td>ب</td> <td>ب</td>	8.2 Y +12 +12 6145 70 2								ب	ب	ب
64 83.0 87.0 89.0 86.5 87.0 89.0 87.0 87.0 87.0 87.0 87.0 87.0 87.1 87.0 87.1 87.1 87.1 87.1 87.1 87.1 87.1 87.1 87.1 87.1 87.1 87.0 <	8.2 Y +12 +12 9818 78 3									81.0	
51 83.0 87.0 89.0 86.5 84.0 87.0 87.0 58 43.2 90.8 90.8 89.7 87.5 87.3 50 86.0 48.0 86.5 84.0 83.0 82.5 81.0 54 93.0 94.0 92.5 97.0 91.0 90.0 81.0 116 L L L 179.0 83.0 87.0 87.0 87.0 103 86.5 87.0 87.5 87.0 87.0 87.0	8.7 Y +10 +10 5318 K6 3					.					
58 43.2 90.8 99.7 84.6 87.3 50 86.0 44.0 86.5 84.0 83.0 82.5 81.0 54 93.0 94.0 92.5 97.0 91.0 90.0 87.0 81.0 116 L L L L R 86.5 87.0 83.5 81.5 10.3 R 86.5 87.0 89.5 84.0 87.0 87.0			83.0								
54 93.0 94.0 92.5 97.0 91.0 90.0 1.1				_						84.2	A5.0
54 93.0 94.0 92.5 97.0 91.0 90.0 116 L L L 79.0 83.0 86.5 87.0 85.0 83.5 103 84.5 85.0 87.5 89.5 88.0 87.0 78 86.2 87.0 87.7 88.8										90.0	78.0
116 L L L 79.0 A3.0 86.5 B7.0 A5.0 A3.5 10.3 A4.5 A5.0 A7.5 B9.5 AA.0 A7.0 A7.0 A7.0 A7.0 A8.4			93.0								
29.30 103 84.5 85.0 87.5 89.5 88.0 87.0 87.0 88.8	2 Y +10 +10 19585 81	116	لب							82.0	A1.0
30.12 78 86.2 87.0 87.7 88.8	8.2 Y +10 +10 23181 72	29-30-103		_						85.0	A3.0
	06 414 01+ 01+ 4 5				_					87.4	9K.1

TABLE F-I (Continued)

	⊢α∢; u.Σ(4 2 1		ţ			PRIMAR	PHIMAHY R.F.	OCTANE	NE NO		REUUIREMENTS•	EMENTS	A1	A Q	
NO NO CODE	1 S C.R.	R RCU 1	TST MILES	IMP HARO	HUM	1000	1250 1500	1500	1750	1750 2000 2250	1	2500 2750 3000	2750	3000	1250	3500
310 8 LCS 225	F A 8.2	y •10 •	10 10491	80 30.06	9 20					82.0	84.0	87.5				
314 3 LCS 225	F A 8.2	[+ 72+ x	110 24451	76 30.07	7 52							85.0	85.0	84.B	84.0	93.0
53 4 LC7 228	F A 8.5	+ 6: + Z	8 6499	67 29-13	3 62					11.0	78.0	78.0	78.0	78.0	77.5	77.0
60 30 LC7 228	F A B.S	• 9 •	6 903R	52 29.34	4 68						81.0	85.0	90.0			
154 44 LC7 228	F A 8.5	× 8 • ×	8 19280	80 29.63	36 €							82.0	84.5	0.5A		
186 28 LC7 229	F A 9.5	Y + 8 +	A 17497	82 29.24	4 138	ر	ب	_	ب	_	78.0	5.61	19.0	78.0	ب	ب
284 7 LC7 228	F A 8.5	Y + 2 +	2 5100	74 29.73	3 80					80.0	83.6	84.3	84.0	A3.1	82.4	H1.6
305 8 LC7 228	F A 8.5	× × ×	2 6224	85 30.21	1 73						80°u	84.5	0.58			
1 22 LIA 238	F. A A.0	Y +15 +1	15 10285	70 29.44	4 51				0.06	88.0	0.58	83.5	81.5	A0.0	78.0	
32 4 LIA 238	F A 9.0	y +15 +1	118 11861	AR 29.15	5 109			86.0	87.5	88.0	87.0	85.5	84.5	A3.5	82.5	41.5
140 29 LIA 23H	F A 8.0	Y +15 +1	15 15820	10 29.81	1 52					91.0	5.06	89.0	87.5	86.0	84.5	85.0
144 29 LIA 238	F A 8.0	Y +15 +1	+15 9821	70 30-17	1 52				0.06	89.5	87.5	86.5	86.0	A5.0	84.5	
154 44 LIA 238	9 A 8.0	Y +15	+15 4462	A0 29.34	4 B3				94.5							
168 5 LIA 238	F A 9.0	Y +15 +1	+15 10419	75 30.07	49 1					89.5	88.5	87.0	86.0	A5.0		
207 29 LIA 238	F A A.0	Y +15 +1	+15 16191	46 29.20	n 86	87.0	87.5	89.0	91.0	91.0	0.06	85.0	A7.0	A5.5	94.5	A3.0
351 46 LIA 238	F A 8.0	Y + 5 +	5 7953	74 29.10	3.5		45.5	88.5	0.06	0.06	87.5	85.5	84.5			
367 26 LIA 238	F A B.O	Y +13 +1	0865 51	99 29.98	я 114			0.06	91.0	A9.0	86.5	83.0	91.0	70.5		
403 47 LIA 238	C A 8.0	Y +12 +1	18761 51	70 29.6A	А 50	86.n	86.5	87.5	8A.5	92.0	0.68	A7.0	A4.5	78.0		
309 A LIW 449	F A 8.1	Y +12 +	+12 18431	A0 29.71	79 1		0.06	A8.5	87.0							
190 28 64 441	F A 8.0	Y +15 +1	15 12490	7A 29.31	1 120			85.5	B7.0	H9.0	91.5	95.5	5116	0.06	AH.5	AR.0
202 28 [4 44]	F A 9.0	Y +13 +1	15 16185	61 29.44	4 107			H3.5	86.5	89.0	30.0	2.06	0.06	90.0	44.0	A7.0
317 26 14 441	F A 8.0	1 + 12 + 1	125 12519	70 30.10	0 7 0					84.0	98.5	0.06	40.0	R. S.	R6.5	85.5

TABLE F-I (Continued)

33A 46 M, 223 F 24A 32 MCA 133 F 253 32 MCA 133 F						1		PHIMARY R.F.	ָרָב מני	OCTANE NUMBER	OMDE:N		FMCNI			
M. 223 MCA 133 MCA 133	S C.R.	RC0	TST MILES	T M L	HARO HIM	1000		1250 1500 1750 2000 2250	1750	2000	2250	2500	2500 2750 3	3000	3250	1500
32 MCA 133	0.6 A	. 9 + ⊁	• 6 17006	76	29.60 42						87.5	88.0	86.0	A5.0		
32 MCA 133	A A.A.) 01+ ×	1165 011	45	79.53 69					0.06	90.0	89.0	88.6	84.1		
	A 8.6	Y •10	+10 11815	A 5	29,29 60					87.0	86.7					
255 32 MCA 133 F	A 8.6	Y •10	•10 7589	18	29.30 65					95.0	94.A					
312 R MCA 133 F	A 8.6	¥ +10	+10 13166	90	29.76 54						0.06	88.0	85.5	A4.0	83.0	A2.0
364 26 MCA 133 F	A 8.6	+	• 7 11833	3 86 30.00	00.00					88.0	86.5	84.0	н3.0	82.0	н1.0	A0.5
243 32 MCA 223M F	0.0 M	, 9 + 1	+ 6 5921	A.S	29.38 64		90.8	8 92.0	7.16 (8.06	0.06					
314 R MCA 223M F	. 0 . 0	\$ •	+ 6 5606	5 80 30.10	37					84.0	89.0	89.0	89.0	98.0	87.0	
262 32 MCA 242 F	8.8 ₹		• 6 11111	A5	29.41 69					91.0	2.06	0.68				
261 32 MCR 141 F	A R.6	Y +12	+10 12954	85	29.20 60					91.0	90.06	A1.4	A5.4	84.9	82.A	A2.0
204 28 MI 242 F	A 8.8	• • •	• 6 19969	8	29.55 87			A7.0	0.00 (91.0	89.5	87.0	A5.0	79.0	93.0	
264 37 MI 242 F	A 8.8	ن • ≻	+ 6 14947	96	29.45 62				6.46	0.56	92.7					
781 7 MI 242 F	A 8. B	· 0 *	• 6 14570	7.1	30.20 51			87.0	89.5	91.0	92.0	91.8				
245 32 MI 250 F	A 8.4	¥ +10	+10 17085	85	29.50 64			0.06	0.06 (90.0	89.9	89.0				
246 32 M V250 F	4.8 A	, 9 + Y	1106 9 .	5	29.44 66				90.0	89.0						
260 32 M V250 F	A 8.4	٠ ٠ ٠	+ 6 7954	95	29.35 69				2.00	91.0	86.9	96.0	A5.3			
307 A M V250 F	7.8 W	ن • ≻	+ 6 13643	3 80 29.80	9.80 73			84.0	88.5	85.0						
143 29 MW V258 F	A 9.3	Y +12	16691 21+	1 70 30.20	0.20 54	92.0	n 42.0	91.5	91.5	91.0	40.1	0.06	89.5	A9.0		
254 32 MW V258 F	A 8.3	v •10	+10 5569	AS	29.46 60		91.0	0 41.0	90° (90.4	90.1					
315 R MW V2585 F	A 8.3	v •10	+10 7466	5 RO 30.05	0.05 54		84.5	5 86.0	0.58 (84.0						
15 27 NLV 225 F	A 8.2	21. N	15101 511	7.0	29.52 50					76.5	79.0	86.0	A7.0	A5.5	83.5	A. 1.0
42 4 NLV 225 F	A A.2	۲ -	112 8420	85.65 ET 1	9.28 96			85.5	5 A6.5	H7.5	AB.0	9H.0	9. A. O.	A 7 . D	85.5	A5.0

TABLE F-I (Continued)

										•													F-
	3500	44.5	A5.0	A0.5	80.5	A 3.5	84.5	94.5	A2.0	77.5	84.1	A4.0		HO.0	91.0	A. A.	84.0		91.6	AA.0		AA.0	A7.0
Mda	3250	86.5	я5. я	82.0	A.1.5	84.0	45.0	84.5	83.0	78.5	A4.4	84.5	95.4	81.5	81.0	86.S	85.0		91.8	89.5		90.9	83.5
	3000	A5.0	86.2	84.0	82.0	A4.0		86.0	94.0	79.5	94.9	A5.0	я7.3	A2.0	A4.0	9.7A	86.5		40.1	91.1		92.0	A. 5.
EMFNTS	2750	H4.0	86.2	A3.0	81.5	84.0		85.0	84.5	80.5	H5.7	85.5	A.9.	5.67	85.0	A7.0	H7.5	89.5	A 9 . B	91.6			87.5
	2500	83.0	85.0		78.0			H2.0	85.0	82.0	86.8	86.0	89.B	78.0	86.0	87.0	88.5	0.06	89.0	1.68	82.0		40.0
	1 .	82.0	83.5						86.0	92.0	88.8	86.5	0.06	76.0	86.0	86.5	89.0		86.1		84.0		A
PPIMARY R.F. OCTANE NUMBER	750 2000 2250	91.0	82.0						86.5		87.6	88.0	90.0		85.0	85.0	88.5		87.2		80.0		
0CTA	1750	80.5							87.5		86.0	86.5			84.5			94.5	86.2				
Y R.F.	1250 1500 1750	79.5							88.5		84.8	85.5											
PHIMAR	1250								0.78		84.0												
	1000								85.5														
	.	·c	_		_	•	_	•	_	~	_	۰.	0:	_	•		_				•	0.	~
	H) I	٦. مم	0 т	9 100	я 80	1 42	4 108	6119	4 50	8 5A	1 50	0 85	7 52	5 50	R 102	7 66	2 38	14 6	4 76	7 64	99	2 62	E 0.1
	BARO	29.45	29.38	29.89	29.08	30.01	30.04	29.90	10 29.54	30.18	70 30.11	29.60	76.65 07	29.45	29.0A	29.27	30.32	29.59	29.94	30.07	79.67	30.32	16.65 46
	M T I	62	52	6	7.0	7.0	ď	46		7.0		7.8		20	ጸ	41	49	22	A)	16	90	7.8	
	ILES	16062	136	Œ	_	~	0	စ္	Σ	326	67	0	_	Ξ.	3	ō.	75	4	9.1	920	ж01	H27	1915A
	ĒΣi		18	14998	6333	11107	8.390	11696	9475	_	6767	14670	118311	23003	8924	18349	36.175	6404	15481	2	27	=	
< < 1	TST M	•18	+18 18	÷	•18	1 81.	+19 8	118 11	+12 5	11 21+	+12	+15 14	115 15	•16	•	+10 18	•10	•10	•10	10 20	10 21	11 01.	•10
	RCU TST M		18			=	œ	=	Ċ.	Ξ		7	==		9	=				2	27	=	
A A D A A A A A A A A A A A A A A A A A	C.R. R RCD TST M	8.6 Y .14 .1H	8.6 Y +19 +18 18	8.6 N +18 +18	8.6 N +18 +18	8.6 Y +18 +18 1	8.6 N +18 +18 8	8.6 Y -18 -18 11	8.6 N +12 +12 9	4.6 N +12 +12 11	8.6 Y +12 +12	8.6 Y +12 +12 14	8.6 N +12 +12 12	8.2 Y +10 +10	9 . 4 . 4 2.8	8-2 N -10 -10 18	01+ 01+ x 2+8	A.2 Y +10 +10	8.2 Y +11 +10	8.2 Y +10 +10 20	8.2 Y +10 +10 27	8.2 N +10 +10 11	8.2 Y +10 +10
ADVA	S C.R. R RCD TST M	Y +14 +1H	Y +18 +18 18	A N +18 +18	N +18 +18	Y +18 +18 1	8 81+ B1+ N	Y +18 +1H 11	F M 8.6 N +12 +12 9	F M 9.6 N +12 +12 11	F M 8.6 Y +12 +12	F M 9.6 Y +12 +12 14	C M 8.6 N +12 +12 12	2 Y +10 +10	9 + 4 + 4 2	2 N -10 -1U 18	01+ 01+ x 2	2 Y +10 +10	7 +11 -10	Y +10 +10 20	75 010 010 7 5	11 01 · 01 · N ~	Y +10 +10
E H A DIVA	T S C.R. R RCD TST M	215 F A 8.6 Y +1H +1H	216 FA 8.6 Y +18 +18 18	216 FA8.6 N +18 +18	216 F A 8.6 N +18 +18	216 F A 8.6 Y +18 +18 1;	216 F A 9.5 N +1A +18 8	216 FAB.6 Y +18 +1H 11	214M F M 8.6 N +12 +12 9	216M F M 8.6 N +12 +12 11	216M F M 8.6 Y +12 +12	216M F M 8.6 Y +12 +12 14	216M C M 8.6 N +12 +12 12	225 F A 8.2 Y +18 +18	225 CA 9.2 Y+6+6	225 F A 8.2 N +10 +10 18	225 F A 8.2 Y +10 +10	225 F A R.2 Y +10 +10	225 F A 8.2 Y +11 +10	225 F A 8.2 Y +10 +10 20	225 F A 8.2 Y 10 10 27	225 F A 8.7 N +10 +10 11	225 FA8.2 Y +10 +10
E H A DIVA	COUR TS C.P. R RCU TST M	NLA 215 F A 8.6 Y +14 +14	NLn 216 F A 8.6 Y +18 +18 18	NLO 216 F A 8.6 N +18 +18	NL9 216 F A 8.6 N +18 +18	NL9 216 F A B.6 Y +18 +18 1	NLO 216 F A 9.5 N +1A +18 8	NL9 216 F A B.6 Y +18 +18 11	NL9 216M F M 8.6 N +12 +12 5	NL9 216M F M 9.6 N +12 +12 11	NL9 216M F M 8.6 Y +12 +12	NL9 216M F M 8.6 Y +12 +12 14	NL9 216M C M B.6 N +12 +12 12	NCS 225 F A 8.2 Y +10 +10	NCS 225 C A 8.2 Y + 6 + 6	NCS 225 F A 8.2 N +10 +10 18	225 F A 8.2 Y +10 +10	NCS 225 F A R.2 Y +10 +10	NCS 225 F A 8.2 Y +11 +10	NCS 225 F A 8.2 Y +10 +10 20	NCS 225 F A B.2 Y +10 +10 27	F A 8.7 N +10 +10 11	NCS 225 F A 8.2 Y +10 +10
ANDA A BUNA ADVA	CODE TS C.R. R RCD TST M	215 F A 8.6 Y +1H +1H	216 FA 8.6 Y +18 +18 18	216 FA8.6 N +18 +18	216 F A 8.6 N +18 +18	216 F A 8.6 Y +18 +18 1;	216 F A 9.5 N +1A +18 8	216 FAB.6 Y +18 +1H 11	214M F M 8.6 N +12 +12 9	216M F M 8.6 N +12 +12 11	216M F M 8.6 Y +12 +12	216M F M 8.6 Y +12 +12 14	9 216M C M 8.6 N +12 +12 12	225 F A 8.2 Y +18 +18	225 CA 9.2 Y+6+6	225 F A 8.2 N +10 +10 18	F A 8.2 Y +10 +10	225 F A R.2 Y +10 +10	225 F A 8.2 Y +11 +10	225 F A 8.2 Y +10 +10 20	5 225 F A B.2 Y +10 +10 27	NCS 225 F A 8.7 N +10 +10 11	225 FA8.2 Y +10 +10

TABLE F-I (Continued)

		_			_		_	_	_	_		_							_				
	0056	A7.0			7A.0	79.5	90.0	97.5	78.0	79.0		40.0	-						A5.0				
A C	3250	A3.0			79.0	HO.0	81.0	A3.4	80.0	A1.0		A].0	76.0						85.2				
AT .			A2.0	46.5	90.0	A0.5	92.0	A4.A	81.5	A2.5		A2.0	77.5					A3.0	85.5	43.0		A5.0	
MENTS.	2750		B3.0	0.78	A2.0	из.0	82.5	96.0	92.0	85.0	74.5	A3.0	0.62			84.5		84.5	86.5	84.8	84.5	45.5	
PEQUIPEMENTS.	2500 2750 3000		83.5	88.0	83.0	81.5	93.5	85.5		0.78	16.0	0.48	81.0			86.0		86.0	87.2	86.2	96.0	86.5	
			84.5	88.S	19.0	82.5	85.0	91.0		84.0	77.5	0.48	82.5	86.0	84.0	87.5		88.0	49.5 €	84.0	89.0	87.5	A1.5
PRIMARY R.F. OCTANE NUMBER	1250 1500 1750 2000 2250		45.0 B	80.08	_	83.0 B	86.0 8	3 0		81.0 B	HO.0 7	84.0 8	33.0 8	91.0 8	A 0.8	AA.0 A	0.26	90.09	90.A	89.0	8 0.68	89.5 8	89.0 A
CTANE	02 0		86.0 H	89.5 8		A1.5 A	à			æ	æ	œ	84.0 3	6	98.0 B	86.5 A	91.4 9	91.0 9	97.5 90	88.0 8'	88.0 8	91.0 89	99.5 BC
۳.	1250 1500 1750														e.						88	16	œ
ARY R.	1500		42.0	0.00 0		A0.0							84.5			5 H5.0	0.06	5 91.0	86.5	5 85.0			
PRIM	1			0.06									85.0			83.5		88.5		A2.5			
	1000	82.0		92.0									86.5			HZ.0		86.0				•	
	M H	50	04	51	50	128	36	90	19	136	50	50	50	51	99	58	5,8	122	æ	51	5.8	85 87	24
	HARO F		30.30	30.22	29.36	79.33 1	10.34	30.02	30.12	30.01	29.84	29.80	59.49	56*62	30.07	29.64	30.08	29.45	29.20	26.62	79.55	29.70	19.62
	AMB TMP R		68 3	72 30	70 2	92 2	68 J	70 3(75 3(A B 3(2 02	70 2	70 2	11 2	70 3	202	12 31	A1 2	66 2	70 20	7.8	74 29	76.20
	ODUM MILES		1493	2164	5384	15933	2555	10282	1653	1506	06030	6188	5985	91551	9271	9550	7033	19291	9565	10647	12293	09621	11921
NCE	AS TEST	•10	•10	•10	٠	æ	+ 2	80	æ	80	• 2	\$	4	4	•	+15	4	3	4	* *	3 .	4	
-	R RCD	Y +10	0 •	Y +10	~ *	¥ + B	Y + 2	¥ + 8	£ + >	¥ • 5	4 + 6	+ +	4 • *	02+ ¥	4 + 5	Y •16	→	*	7 + ×	Y + 3	7 + Y	• •	+
	C.R.		A. 2	8.2	8.5	8.5	A.5	A.5	8.5	8.5	8.5	8.5	8.5	8.6	8.2	8.0	8.6	8.3	8.3	8.3	8.3	A.3	8.3
- 2 4 .	z v. i u → u i	CA	E L	I	4	4	A P	A P	4	M M	V	ر V	Ĭ L	CA	¥	ر ک	CA	Ā	M.	4	M M	4	W.
	HICLE	522	225M	225M	228	228	828	828	228	228	822	928	22AM	650	457	238	1 450	544	544	544	544	544	244
:	- I	47 NCS	SON 62	S MCS	72 NC7	4 NC7	29 NC7	7 NC7	3 NC7	26 NC7	47 NC7	47 NC7	72 NC7	41 NFH	29 NFL	47 NIA	41 NTH	ZA NIJ	Ju ng	7 NI.	46 NI.1	46 NIJ	46 NIJ
	OFIS LA		150 2	163	10 2	96	14H 2	295	317	354 2	381 4	396 4	- H	7 627	123.2	398 4	4 Y 0 4	5 602	2 602	285	331 4	3,34 4	4 45.6

TABLE F-I (Continued)

	1500			A4.0		86.5		A9.0	AB.0							R6.8			91.0	79.5	78.0	A0.0	
¥ 1				84.0	84.0	87.5		89.0	AA.0				87.0		84.0	48.6		80.5	84.5	80.0	A0.5	82.5	
A 1				86.5	A5.0	₽₩.0			98.0		86.0	96.0	A7.5		R4.7	400		A1.5	₽5.4	A1.0	93.0	A3.0	B4.9
EMENTS	2750	86.5	86.5	87.0	8.98	89.0			98.0		86.5	97.0	88.5	80.0	85.8	80.5		H3.5	86.5	B2.0	A5.0	84.5	84.5
REGUIREMFNTS.	2500	81.5	0.78	87.5	88.0	0.06			8A.0	85.5	87.0	88.0	89.5	81.0	87.3	88.2		R5.0	87.0	я3.0	A6.0	R6.0	94.0
NUMBER	2250	89.0	87.5	88.5	89.0	91.5	84.0		0.68	84.5	88.0	88.5	0.06	82.0	0.06	87.0		86.5	88.0	84.5		88.0	
	2000	89.0	89.0	A9.5	5.06	92.5	97.0		89.5	96.0	92.0	89.5	91.0	84.0	99.4	H5.6	86.5	87.5	0.6H	85.5		0.06	
OCTANE	1750		91.0	0.06	91.5	91.5	9.6		49.5	86.0	93.0	0.06	92.0	84.5	A7.0	84.2	81.5	88.5	AA.5	96.0		0.00	
PPIMARY R.F.	1500			A.0	89.0	0.06					92.5	90.5	92.0				86.0		R7.5	85.0		46.0	
ры Іман	1250 1500										92.0	99.0	99.0									A3.0	
,												85.0		,								80.0	
	# !	64	1 74	74 (7	1,75	69	19	57	1 59	5.0	£ .	134	49	5.0	20	54	50	114	55	1.57	, 50	# J
	HARO	29.66	29.63	14.65	29.44	29.50	A0 29.90	30.12	81 30.02	30.18	79.45	29.57	29.98	10.01	30.25	10.20	30.11	29.45	29.18	28.50	10.10	70 29.66	29.10
AMA		18	74	73	99	2	90	75		7.0	70	99	89	7.0	7.0	7.0	g.	11	41	7.8	4	7.0	Ą
MOOD	MILES	10194	17262	11064	15921	20498	15299	8925	7186	12709	9572	17130	6574	9306	9448	6311	19749	18438	5473	12600	9679	13100	9147
SPARK ADVANCE	- ,	4	4	•10	•10	01+	•10	• 10	•10	+13	*	4	4	÷	\$	4	4	•10	•10	•10	•10	•10	.17
	2 1	4	4	01+	V •10	•10	Y •10	•10	•10	• 13	•	3	4	•	4	6 0	4	Y •10	1 .10	Y +10	y •10	. •12	6 •
<	C.B.	8.1 ⊀	8.3 Y	B.6 Y	8.6	₩.4 ¥	¥.6	× ••	y . A. A	₽.0 Y	8.6 ∀	8•6 ∀	8.6 Y	٠3 ٧	٠3 ۲	8.3 Y	R.3 Y	A. A.	Ŷ.	A.A.	A.6	A.6 ×	9.0
⊢ 2 ≪ Z ₩ Σ U	(C)	F A 8	F A B	F A B	F A R	F A 8	4 4	F A B	F A B	F A P	F A 8	F A B	₩ ₩	F A 8	F A A	F A B	4	4	4	F A A	4	C A P	F A 9
	;	544		23#	238	2.38	238	238	238	23H	450	450	450	544	546	264	546	238	238	5.38	238	238	223
LAH VEHTCLE		46 NI J	46 NI.J 244	7 7	2A NIK	ĭ	ž	Σ	26 NIK	V	ĭ	Ĭ	Ţ	3	3	3	3	22 NK 2	ž	¥	ž	47 NK 2	ಕ
חמי ויאט		344 46	345 46	57 4	204 28	210 2A	300 A	321 3	37 - 76	132 29	14 22	205 28	37 nTF	124 29	7 816	29.> 1	301 A	13 22	30 6	4 64	320 3	191 47	254 32

TABLE F-I (Continued)

F A 9.0 Y · H · 6 F 7918 RA F 29.54 64 F A 9.0 Y · H · 6 F 7918 RA F 29.55 62 F A 8.6 N · 110 · 110 5545 R0 F 29.08 67 F A 8.6 N · 110 · 110 5545 R0 F 29.08 67 F A 8.6 N · 110 · 110 6440 F 29.45 64 F A 9.0 N · F · 6 F 1725 R0 F 29.16 58 F A 9.0 N · F · 6 F 1725 R0 F 29.16 58 F A 9.0 N · F · 6 F 1725 R0 F 29.45 111 F A 9.0 V · F · 6 F 1855 R0 F 29.45 87 F A 9.0 V · F · 6 F 1855 R0 F 29.45 80 F A 9.0 V · F · 6 F 1855 R0 F 29.45 80 F A 9.0 V · F · 6 F 1855 R0 F 29.45 80 F A 9.0 V · F · 6 F 1855 R0 F 29.45 80 F	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	m Σ (- 3 4 3	ADVAN					!	PHIMAR	PHIMARY R.F. OCTANE	0077	NENU	NUMBER	RE UNIR	REQUIREMENTS. AT	S. AT	RPM	
12 0L 223 F A 9.0 Y · H · 6 791B R 6 29.55 6.4 89.0 R9.0 R9.9	10 t		R RCD		E E		MIT	1000	1250	1500	1750	2000 2250	2250	2500	2750 3000	3000	3250	3500
37 OL 223H F M 9.0 Y · 4 · 6 31117 85 29.45 64 94.1 94.9 95.0 4 NCA 133H F M 9.0 Y · 4 · 6 31117 85 29.45 64 94.1 94.9 95.0 4 NCA 133H F M 8.6 N · 10 · 10 5545 80 29.08 61 94.1 94.9 95.0 3 NCA 133H F M 8.6 N · 10 · 10 10 29.07 75 80.25 80 80.07 75 4 NCA 133H F M 9.0 N · 6 · 6 10 29.04 63 75 80.55 80 80.55 80 80.55 80 80.55 80 80.55 80 80.55 80 80.55 80 80.55 80 80.55 80 80.55 80 80.55 80 80.55 80 80.55 80 80.55 80 80.55 80 80.55 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80	32 OL 22	.6 ₽	ac		96	9.54	44					83.5	84.5	85.9	A7.0	A7.0		
4 0C4 133	32 OL	ō T	•		85	3.55	29			0.68	88.9	1.18	87.0					
4 DCA 133 F A 8.6 N · 10 · 10 · 5945 R0 29.08 63 R9 R9.08 63 R9.5 R9.5 R9.5 R9.5 R9.5 R9.5 R9.5 R9.5	12 OL	Σ.	•	in.		3.45	49		94.1	6.46	95.0	92.H						
3 0 0 0 0 2 2 3	4	€	•10			9.0A	63			84.5	85.5	84.0	86.0	86.0	45.5	A5.0	84.5	H4.0
47 OCA 223 F A 9-0 N + 6 + 6 5728 R2 29-15 58	3 004 13	A 8	•10		62	16.6	75							92.0	81.5	95.0	83.5	82.0
4 DCA 223 F A 9.0 N · 6 · 6 6199 71 29.52 58 30 DCA 223 F A 9.0 N · 6 · 6 6199 71 29.52 58 31 DCA 223 F A 9.0 Y · 4 · 4 4404 49 29.42 62 32 DCA 223 F A 9.0 Y · 6 · 6 1855 60 29.44 111 33 DCA 223 F A 9.0 Y · 6 · 6 1855 60 29.44 111 34 DCA 223 F A 9.0 Y · 6 · 6 1855 60 29.44 111 35 DCA 223 F A 9.0 Y · 6 · 6 10154 91 30.21 66 36 DCA 223 F A 9.0 Y · 6 · 6 10154 91 30.01 122 37 DCA 223 F A 9.0 Y · 6 · 6 10154 91 30.01 122 38 DCA 223 F A 9.0 Y · 6 · 6 10154 91 30.01 122 39 DCA 223 F A 9.0 Y · 6 · 6 10154 91 30.01 122 39 DCA 223 F A 9.0 Y · 6 · 6 10154 91 30.01 122 39 DCA 223 F A 9.0 Y · 6 · 6 10154 91 30.01 122 39 DCA 223 F A 9.0 Y · 6 · 6 10154 91 30.01 122 39 DCA 223 F A 9.0 Y · 6 · 6 10154 91 30.01 122 30 DCA 223 F A 9.0 Y · 6 · 6 10154 91 30.01 122 30 DCA 223 F A 9.0 Y · 6 · 6 10154 91 30.01 122 30 DCA 223 F A 9.0 Y · 6 · 6 10154 91 30.01 122 30 DCA 223 F A 9.0 Y · 6 · 6 10154 91 30.01 122 30 DCA 223 F A 9.0 Y · 6 · 6 10154 91 30.01 122 30 DCA 223 F A 9.0 Y · 6 · 6 10154 91 30.01 122 30 DCA 223 F A 9.0 Y · 6 · 6 10154 91 30.01 122 30 DCA 223 F A 9.0 Y · 6 · 6 10154 91 30.01 122 30 DCA 223 F A 9.0 Y · 6 · 6 10154 91 30.01 122 30 DCA 224 DCA 225 F A 8.0 Y · 6 · 6 10154 91 30.01 122 30 DCA 224 DCA 225 F A 8.0 Y · 6 · 6 10154 91 30.01 122 30 DCA 224 DCA 225 F A 8.0 Y · 6 · 6 10154 91 30.01 122 30 DCA 224 DCA 225 F A 8.0 Y · 6 · 6 10154 91 30.01 122 30 DCA 224 DCA 225 F A 8.0 Y · 6 · 6 10154 91 30.01 122 30 DCA 224 DCA 225 F A 8.0 Y · 6 · 6 10154 91 30.01 122 30 DCA 224 DCA 225 F A 8.0 Y · 6 · 6 10154 91 30.01 122 31 DCA 225 F A 8.0 Y · 6 · 6 10154 91 30.01 122 31 DCA 225 F A 8.0 Y · 6 · 6 10154 91 30.01 122 31 DCA 225 F A 8.0 Y · 6 · 6 10154 91 30.01 122 31 DCA 225 F A 8.0 Y · 6 · 6 10154 91 30.01 122 31 DCA 225 F A 8.0 Y · 6 · 6 10154 91 30.01 122 31 DCA 225 F A 8.0 Y · 6 · 6 10154 91 30.01 122 31 DCA 225 F A 8.0 Y · 6 · 6 10154 91 30.01 122 31 DCA 225 F A 8.0 Y · 6 · 6 10154 91 30.01 122 31 DCA 225 F A 8.0 Y · 6 · 6 10154 91 30.01 122 31 DCA 225 F A 8.0 Y · 6 · 6 10154 91 30.01 122 31 DCA 225 F A 8.0 Y · 6 · 6 1015	47 OCA 1	€	•	_	70	3.75	50			82.0	83.5	0.68	89.0	89.0	87.5	A4.0	8].5	90.08
30 0CA 223	4 DCA	6	٠ •		82	3.16	58			÷	86.5	87.0	87.5	88.0	98.5	89.n	84.5	98.0
30 0.Ca 2.2.3 F A 9.0 Y · 6 · 6 17255 80 29.46 111 78.0 81.0 89.46 111 81.0 81.0 89.46 111 81.0	30 OCA 22	.6 ▲	•		7.1	55.6	5.8							83.0	85.5	A 3.0		
24 OCA 223 F A 9.0 Y · 6 · 6 17255 80 29.46 111 24 OCA 223 F A 9.0 Y · 17 · 17 7380 A5 29.15 69 37 OCA 223 F A 9.0 Y · 17 · 17 7380 A5 29.15 69 46 OCA 223 F A 9.0 Y · 17 · 17 7380 A5 29.15 69 46 OCA 223 F A 9.0 Y · 6 · 6 1120R 86 29.79 36 56 OCA 223 F A 9.0 Y · 6 · 6 10154 91 30.00 122 4 OCA 223M F M 9.0 Y · 6 · 6 10139 79 29.09 62 B4.0 B7.4 B7.0 37 OCA 223M F M 9.0 Y · 10 · 10 10 8256 78 29.09 62 B7.4 B7.4 B9.4 90.0 38 OCA 223M F M 9.0 Y · 10 · 10 10 8256 78 29.09 62 B7.4 B7.4 B9.4 90.0 39 OCA 223M F M 9.0 Y · 10 · 10 10 8256 78 29.09 62 B7.4 B7.4 B9.4 90.0 39 OCA 223M F M 9.0 Y · 10 · 10 10 8256 78 29.02 100 B7.4 B7.4 B9.4 90.0 39 OCA 242 F M 8.8 Y · 6 · 6 5475 74 30.27 100 B8.0 B7.4 B9.4 B9.0 B9.0 50 OCA 242 F	30 OCA	A 9.	•		64	3.45	29						0.46	94.5	90.5			
24 OCA 223 F A 9.0 Y · 17 · 17 · 17 7360 A5 29.15 69 7 R.0 7 R.0 R.0	28 OCA	*6 ¥	•	_	80	1.46]	111					83.0	87.0	89.0	86.5	A4.5	83.0	92.0
12 OCA 223	2H OCA	6	•	_		3.34	69			78.0	A1.0	84.0	85.2	86.0	86.5	86.0	84.0	A1.0
7 OCA 223 F A 9.0 N · 3 · 6 B360 70 30.21 66 46 OCA 223 F A 9.0 Y · 6 · 6 10154 91 30.00 122 4 OCA 223M F M 9.0 Y · 6 · 6 10039 79 79.08 112 84.0 86.5 88.0 87.0 37 OCA 223M F M 9.0 Y · 6 · 6 10039 79 79.08 112 84.0 86.5 88.0 87.0 38 OCA 223M F M 9.0 Y · 10 · 10 8256 78 29.09 62 4 OCA 223M F M 9.0 Y · 10 · 10 8256 78 29.09 62 5 OCA 223M F M 9.0 Y · 10 · 10 8256 78 29.09 62 5 OCA 242 F A 8.8 Y · 6 · 6 5575 81 29.32 100 5 OCA 242 F A 8.8 Y · 6 · 6 16958 77 74 30.27 52 72 OCA 242 F A 8.8 Y · 6 · 6 16958 77 79.44 110 73 OCA 242 F A 8.8 Y · 6 · 6 16958 77 79.44 110 74 OCA 242 F A 8.8 Y · 6 · 6 16958 77 79.44 110 75 OCA 242 F A 8.8 Y · 6 · 6 16958 77 79.44 110	12 OCA	A 9.	+17		P.	1.15	69						77.0	80.7	A2.0	B2.0	90°5	
46 OCA 223 F A 9.0 Y · 6 · 6 10154 91 30.00 122 4 OCA 223M F M 9.0 Y · 6 · 6 10039 79 79.08 112 84.0 86.5 88.0 87.0 32 OCA 223M F M 9.0 Y · 6 · 6 10039 79 79.08 112 84.0 86.5 88.0 87.0 33 OCA 223M F M 9.0 Y · 6 · 6 10039 79 79.09 62 87.4 89.4 90.0 28 OCA 223M F M 9.0 Y · 10 · 10 8256 78 29.49 87 4 OCA 242 C A 8.8 Y · 6 · 6 575 81 79.32 100 5 OCA 242 F A 8.8 Y · 6 · 6 16958 77 74 30.27 52 32 OCA 242 F A 8.8 Y · 6 · 6 16958 77 79.44 110 33 OCA 242 F A 8.8 Y · 6 · 6 16958 77 79.44 110 34 OCA 242 F A 8.8 Y · 6 · 6 16958 77 79.44 110 35 OCA 242 F A 8.8 Y · 6 · 6 16958 77 79.44 110 36 OCA 242 F A 8.8 Y · 6 · 6 16958 77 79.44 110 37 OCA 242 F A 8.8 Y · 6 · 6 16958 77 79.44 110	7 0CA	A 9.	•		70	15.0	£ £								88.3	9.18	87.0	A6.0
26 OCA 223	46 0CA	A 9.	•	_	86	1.19	36						80.5	83.0	94.0	A2.5	A0.5	
4 OCA 223M F M 9.0 N + 6 + 6 10039 79 79.08 112 84.0 A6.5 8A.0 A7.0 32 OCA 223M F M 9.0 Y + 6 + 6 8069 85 29.09 62 87.4 89.4 90.0 28 OCA 1223 F A 9.0 Y + 10 + 10 8256 78 29.49 87 4 OCA 242 C A 8.8 Y + 6 + 6 5675 A1 29.32 100 5 OCA 242 F A 8.8 Y + 6 + 6 16958 77 29.44 110 28 OCA 242 F A 8.8 Y + 6 + 6 16958 77 29.44 110 39 0CA 242 F A 8.8 Y + 6 + 6 16958 77 29.44 110 30 0CA 242 F A 8.8 Y + 6 + 6 16958 77 29.44 110	26 OCA	6 ◀	•	_	91		122				85.5	87.0	0.68	91.0	89.0	98.0	96.0	A5.0
37 OCA 223M F M 9.0 Y · 6 · b 8069 R5 29.09 62 87.4 89.4 90.0 28 OCA 223M F M 9.0 Y · 10 · 10 8256 78 29.49 87 87 85.0 4 0CA 242 C A 8.8 Y · 6 · 6 5675 A1 29.32 100 A8.0 89.0 90.0 5 OCA 242 F A 8.8 Y · 6 · 6 16958 77 29.44 110 A8.5 77 0CA 242 F A 8.8 Y · 6 · 6 16958 77 29.44 110 A7.0 A8.5 77 0CA 242 F A 8.8 Y · 6 · 6 16958 77 29.44 110 A7.0 A9.5 77 0CA 242 F A 8.8 Y · 4 · 6 · 5 16958 77 29.44 110 A7.0 A9.5 77 0CA 242 F A 8.8 Y · 4 · 6 · 5 16958 77 29.44 110 A7.0 A9.5 77 0CA 242 F A 8.8 Y · 4 · 6 · 5 16958 77 29.44 110 A7.0 A9.5 77 0CA 242 F A 8.8 Y · 4 · 6 · 5 16958 77 29.44 110 A7.0 A7.0 A7.0 A7.0 A7.0 A7.0 A7.0 A7.	4 0CA	Σ	٠	-	19		211	64.0	84.5	88.0	A7.0	86.0	84.5	84.0	83.0	A2.0	41.5	A1.0
78 0CA 1223 F A 9.0 Y +10 +10 8256 78 29.49 87 85.0 4 0CA 242 C A 8.8 Y + 6 + 6 5675 81 29.37 100 5 0CA 242 F A 8.8 Y + 6 + 6 9377 74 30.27 52 28 0CA 242 F A 8.8 Y + 6 + 6 16958 77 29.44 110 72 0CA 242 F A 8.8 Y + 6 + 6 16958 77 29.44 110 72 0CA 242 F A 8.8 Y + 4 + 6 5955 85 29.37 64	32 OCA	Σ O	٠		85		29		47.4	89.4	0.06	0.06						
4 0CA 242 C A 8.8 Y · 6 · 6 9377 74 30.27 52 90.0 90.0 5 0CA 242 F A 8.8 Y · 6 · 6 9377 74 30.27 52 91.0 91.0 91.0 91.0 91.0 91.0 91.0 91.0	AN DCA	A 9.	•10		7.8		87				A5.0	86.0	89.0	5.16	90.5	A9.0	87.5	86.5
5 NCA 242 F A B.A Y · 6 · 6 9377 74 30.27 52 24 NCA 242 F A B.A Y · 6 · 6 1695A 77 29.44 110 32 NCA 242 F A B.A Y · 4 · 6 595A 85 29.32 64 91.7	4 0CA	₽ 9.	•		Ę		00		A8.0	89.0	0.06	0.00	89.5	89.0	88.5	A. O.	A7.5	A7.0
24 NCA 242 F A B.A Y + 6 + 6 1695A 77 29.44 110 A7.0 HB.5	5 OCA 24	₩ 8	•				52				91.0	92.0	91.5	0.06	89.0	A A . a	R7.0	86.0
72 OCA 242 F A 8.8 Y + 4 + 6 5456 R5 29.32 64	28 OCA	A 19.	¢	_	17 29		01.0			A7.0	88.5	86.0	84.5	A3.5	H2.5	R 2 . D	81.5	
	420 SE	₽.	÷		AS		44				91.1	H9.0						

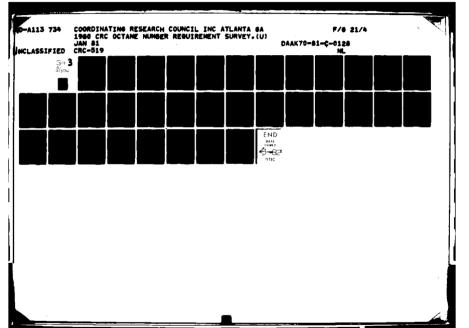


TABLE F-I (Continued)

_	3500									6 A5.0			5 85.0			5 85.5	0 78.0				5 86.2		,,
BPN	1250									85.6			85.5			86.5	79.0				87.5		H7.5
•• ••	0006								94.0	86.A		A6.0	A6.0			87.0	80.0	A3.0	84.7		A9.0		A4.0
EMENT	2750			B7.0		87.0			86.0	88.5		87.0	A6.5			98.0	91.0	83.0	H4.A		9.06	90.0	85.5
REQUIREMENTS.	2500 2750 1000	 	89.0	88.0		88.5			87.5	90.8		87.5	87.0			88.5	81.5	83.3	94.9		92.1	91.0	0.78
			89.6	89.0	85.0	90.5	86.5		88.5	91.0		88.5	87.5			89.0	82.0	83.6	85.0		93.2	92.2	AA.0
N. W.	2000		90.0	90.0	86.0	0.26	AA.0	91.5	0.06	90.0	45.4	0.06	87.5	91.0	6.06	89.5	83.0	94.0	85.2	88.5	95.5	93.2	89.0
PRIMARY R.F. OCTANE NUMBER	1750 2000 2250		0.06	91.0	A9.0	89.5	0.06	93.0	91.0	89.0	92.5	92.0	88.0		A6.0	0.06	84.0	84.3	A5.3	0.06	0.06	91.1	0.68
×	! .		89.0				88.0	91.0	89.0			88.0	88.0			0.06	86.0	84.5	85.4	٠	ŭ	99.0	89.5
HIMARY	1250 1500												A8.0			A5.0	0.06	85.0	85.5			3	90.06
	10001												_			•	93.0	90.0	87.n E				״
	i = i																0	0	Œ				
	¥ ;	60	6.8	4.9	3,	38	24	7	195	54	24	107	1,	69	20	4 5	120	95	47	68	E 7	58	116
	HARO	29.44	74.65	29.50	78 29.46	29.60	29.50	89.68	29.8A	70 30.20	29.45	79 30.03	29.20	29.34	30.32	29.54	29.35	29.40	20.4A	29.18	30.08	80 30.26	96 30.02
•	A T I	95	85	E .	7.8	11	16	75	93	70	95	79	70	35	19	67 6	78 2	73 2	7,	£,	70 3	80 3	96
ě	MILES	11606	7425	12000	12640	16902	16725	17374	8076	2169	12727	17326	9505	12000	13905	11977	14.950	16790	17419	6849	12275	7440	9932
SPARK	151	•	•	9	•	\$	¢	•	9	•10	9	•	•10	3 0	æ	÷	3 0	oc •	æ	•	9 •	9	x
	₩Q.	۳. •	4	•	•	•	•	Æ +	4	•10	~	~	•10	5 0	6 0	÷	6 0	x	±	+12	÷	ç •	x
⋖ •	ς.α. 1	≻	≻ er	Æ	≻	>- co	≻ ec	≻ œ	≻ ec	>	≻	≻	>	>	>	>	>	<u>-</u>	-	>	>	>	>
⊢α « 2		₽.8	A 9.8	₽	A 8.A	A 8.8	A 8.8	₽ 8	A 8.8	A 9.6	A 8.8	A 8.8	A 8.4	A 8.4	A 8.4	A 8.4	A A.4	A 8.4	A 8.4	A A.4	A 8.4	A H.4	A 9.4
m Z (ı – د ا	L	•	4	•	•	L	<u>.</u>	i.	L	4	4	4.	L.	υ	L	i.	u.		4	-	_	4
2 2 2 3 4 4	700E	242	245	242	242	242	245	242	245	141 BO0	245	245	250	250	v250	550	V250	V250	V250	V250	V250	V250	250
2		V OC V	OCA	OCA	46 NCA	46 OCA	46 OCA	46 OCA 242	26 OCA 242		10	0	10	10	10	0 4250	0	0	C	C	c	c	26 N V250
5 2 20		25 n 32	52 32	330 46	332 46	335 46	339 46	340 46		1 0	4 32	5 26	43 6	رد ر ع	0 41	7	9 2A	3 28	2 28	1 32	1 1	٠ ٧	
3	Z !	5	252	33	3	33	33	*	359	280	544	364	4	242	420	7 7	189	193	212	251	77.3	276	361

TABLE F-I (Continued)

		⊢ ~ ~ ~ ?	9 4 !						PRIMAR	PRIMARY R.F.	OCTANE		NUMBER	REGUIR	REQUIREMENTS.	AT	APM	
NO NO CODE	06 1	S C.R.	R RCD TST	MILES	DA I	HARO	MIH I	1000	1250	1250 1500 1	750	2000	2250	2500	2750	3900	3250	45.00
404 3 0 4250		A 8.4	× 9 + ×	17229	63	30.65	01					0.76	90.0	89.0	86.5	84.0		
296 7 0W VZ	V258 F	A 8.3	Y +10 +10	14145	70	26.62	50			87.0	8.8	89.5	90.2	91.0	90.5	89.0	AR.4	A7.A
394 47 0W V2	V258 C	A 8.3	Y •10 •10	10250	70	59.62	20	89.0	89.5	91.0	91.0	91.0	91.0	91.0	90.5	90.5	0.06	0.06
31 4 PL 217	1 L	A 8.2	Y + 8 +12	5405	14	29.07	103				79.0	81.5	82.0	82.0	82.0	81.5	HO.0	78.5
390 47 PL 217	. C	A 8.2	Y + 5 + 5	12960	70	29.70	20				86.0	89.0	87.5	96.0	85.5	85.0	84.5	B4•0
393 47 PL 217) L	A 8.2	Y +12 +10	6800	70	29.74	50					82.0	82.0	82.0	82.0	A2.0	A2.0	A0.0
400 47 PL 217) L	A 8.2	Y + 8 +10	0002 (20 %	29.30	0,7					80.0	82.0	82.0	81.5	80.0	79.0	78.0
417 41 PL 217	. C	A 8.2	Y +14 +10	7631	19	30.00	29							0.06	A9.9	A1.4	84.5	
10 22 PL 21	217H F	N 8.2	N +12 +12	7300	70 %	29.17	50	ب	_	77.0	80.5	81.5	19.0	77.5	76.0	ب	نہ	ب
174 5 PL 21	217M F	м 9.2	N +12 +12	9326	71 5	29.96	54			83.0	86.5	87.0	86.5	85.0	84.0	A3.0		
399 47 PL 21	217M C	M 8.2	Y + 8 +10	10235	70	29.30	20	82.0	84.5	89.0	89.0	89.0	85,5	84.5	83.5	82.5	81.5	80.0
11 22 PC 137	37 F	A 8.4	Y +12 +12	5159	10	29.35	50		86.5	0.06	89.5	88.0	85.5	84.5	82.5	A1.0	90.0	19.0
33 4 PC 137	37 F	A 8.4	N +12 +12	5112	8	29.10	26			92.0	91.5	91.0	90.5	89.5	A8.5	87.0	A5.5	A4.0
137 29 PC 137	37 F	A 9.4	N +12 +12	5054	70	29.65	04		93.0	89.0	97.5	A7.0	86.5	86.0				
272 7 PC 137	37 F	A 8.4	Y +12 +12	5283	70	30.00	20			82.0	86.5	87.3	87.2	1.98	85.5	84.3	83.0	B2.0
327 3 PC 137	37 F	A 8.4	N +12 +12	8276	73	71.62	7.0			92.0	92.0	0.46	89.0	68.0	87.0	98.0	86.5	94.0
328 3 PC 137	37 F	A 8.4	Y +12 +12	1219	73 8	71.62	70					93.0	90.5	88.0	88.0	88.0	88.0	A6.0
352 76 PC 137	37 .	A 8.4	Y +11 +10	7517	76	29.80	611			93.0	89.5	84.0	85.0	84.0	A3.0	A2.0	91.0	90.0
333 46 PC 252	32 F	A 8.5	Y +12 +12	12606	1, 91	29.40	76		85.5	86.0	A6.0	86.0	85.5	95.0	84.5			
337 46 PC 252	32 F	A 8.5	Y +12 +12	20340	78 %	79.61	59		A7.5	0.06	89.5	AA.0						
350 44 PC 252	32 F	A 8.5	Y +12 +12	20550	5	29.77	ĄĹ					AA.0	0.06	89.0	87.5	86.0		
371 24 p 252	L .	A 8.5	Y +12 +12	16231	A.	26.05	108		A7.0	ян.	AA.0	86.0	85.0	84.0	A3.0			

TABLE F-I (Continued)

	3500	40.0	85.n		87.5	83.0	19.0			яв.0	82.0			97.0	18.0	82.0		92.0	A6.6				
¥ dd	3250 3	H2.0	85.5		8A.5	84.0	81.5			88.5	85.5			88.3	0.08	82.5		82.5	87.2	H6.1		84.5	
A	3000	_	87.0		89.5	85.0	84.0			A9.0	A3.0			89.8	82.5	A3.5		A3.0	AB.0	A5.8		A6.0	
NTS.	•		AB.5 A		89.5 A	86.5 8	85.5 8			89.5 A	84.0 A			90.9	84.0 A	84.5 A		83.5 A	89.3 A	86.2 A		86.5 A	
REGUIREMENTS.	2750							•															κ
	2500		0.06 0		0 68.5	5 88.0	5 87.0	0 91.0		5 90.5	5 85.0	ιn		9 91.5	0.98 0	5 85.0	ľ	5 85.0	3 90.8	9.78 0	ır	5 A7.5	4 87.5
NUMBER	2250		91.0	89.0	87.0	89.5	87.5	91.0		91.5	86.5	88.5	78.0	91.9	87.0	86.5	86.5	85.5	91.3	89.0	90.5	88.5	4.68
	2000		91.5	89.5	A6.0	92.0	88.5	90.0	91.4	92.0	91.0	88.0	79.5	91.2	8A.0	87.0	89.5	A6.0	90.0	90.0	92.0	91.0	91.0
	1750 2000		90.5	90.5	84.5	92.5	87.5	89.6	92.0	92.0	90.5		85.0	1.68			88.2		1.18	90.5	93.0	89.0	
PRIMAHY R.F.			85.5	92.0		0.46	87.0	89.3	91.5	91.5			90.0	84.0				85.0	84.5		0.68	H5.0	
ZHARY	1250 1500								90.5									85.5					
	1000																	82.0 /					
	! = ;																	3 0					
	HUM	20	29	55	92	104	11	68	68	59	63	29	60	20	20	20	22	126	15	41	4 8	211	60
	HARO	۰	59.45	29.81	29.47	30.05	59.62	29.39	29.29	29.33	29.93	30.13	36.62	30.05	29.26	29.16	37.12	29.93	30.18	15.65	29.96	29.4R	29.14
	I THE		59 2	2 0 2	39 2	94 3	67 2	AS 2	A5 2	11 2	74 2	A1 3	70 2	70 3	70 2	5 07	72 3	92.2	11 3	A5 2	7 0 7	95 2	A5 2
	MILES	2069	19288	12462	17831	16602	16296	15850	8479	10070	14570	9578	8493	14684	7934	15050	5299	12936	15456	16699	13122	9014	10482
		•12	•10	01.	•10	• 10	•50	+10	•10	3	÷	•10	<u>د</u> •	•10	6 0	8 0	\$	cc •	•10	9	0	\$ 0	• 10
SPABK ADVANCE	PCD TS1		•10	•10	•10	•10	•20	01.	•10	4	÷	æ •	•	÷	c c ◆	÷12	æ. +	œ •	÷	پ	+10 +1	•	81 · N
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⊢α ∢ ∶	S C.R.	A 8.3	A A.3	A 8.3	A 8.3	A A.3	A 8.4	A 8.3	A 8.3	A 8.6	A 8.6	A 8.0	N 9.0	E	A 8.4	A 8.2	A 8.2	A 9.2	A 8.0	A A.0	A 8.9	A 8.4	A A.9
m X		L.	L	u.	la.	•	L	•	L	4	4	ပ	1	L	•	ပ	U	4	4	4	•	•	•
	LAM VEHICLE NO CODE	556	245	245	242	246	S F50	SW V258	SW V258S	NTCH 450	NTCH 450	1%2 UT	N 241M	NTI_0 241M	NTLG 250	1.1. 457	NTLL 457	ML 457	LD 241	01H 258	29 014 149	26 OTM 250	257 32 OVM 149
;	A CA		2A RL	29 PC	2A RC	26 RC	2A S		35 SK	t NT	5 NT	41 NTLD	29 NTLD	7 N.T	22 NT	47 NTI.L	N	25 NTML	Ž ~	32 OT	10 6	10 90	٥ ک
	A CA CA		211.2	141 2	214 2	365 2	201 2	26 945	26A 3	5.	111	408 4	125.2	28.1	213	7 204	407 41	362 2	284 7 NVLD	265 3	124 2	367.2	757

TABLE F-I (Continued)

	F X A →	A AU							PHIMA	PHIMARY R.F.	. OCTANE	ANE N	NUMBER	REQUIS	REGUIREMENTS.	5. AT	H	
OHS LAH VFHICLE. NO NO CODE		- α 1	AS AS RCU TST	S 000M T MILES	S TWD	BARO	I I	1000	•	1250 1500 1750	1750	1750 2000 2250	2250	2500	2500 2750	3000	3250	9500
25R 32 OVN 250	F A A.4	>	+10 +10	0 12638	8 85	5 29.08	60					84.0	85.6	84.9	84.3	82.0		
409 41 AU F?1	C A 8.0	۱ >-	٠ •	3 4294	4 73	30.10	99 0								86.5	A B. A	A9.0	
21 22 H F16	F A 8.2	≻	, Ti	3 13649	9 70	29.39	9 50					ب	ب	ب	۔	ب	76.5	ب
416 41 H F16M	C M 8.2	>	•	0 4856	87 8	56*62	29 5						88.0	1.18	86.5			
54 4 C 114M	F 3.8	z	4	5 12700	69 0	71.62 (89 1	86.5	87.0	84.0	79.0							
136 29 E 212M	F M 8.5	z	•10 •1	0 7853	3 68	1 29.90	15 0							_	ب			
145 29 E 212M	F # 8.5	Z	•10 •10	0 6426	6 70	30-17	7 55		78.0	19.0	77.0	76.5	76.0	76.0				
45 4 8 714	F A 8.5	.	• ec	8 10092	2 68	39.22	55 2			96.0	89.0	90.0	0.06	89.0	88.0	87.0	86.0	85.5
380 47 E 214	C A 8.5	z	+	8 9238	8 70	57.65 (2 50								A7.0	A7.0	86.5	86.0
426 41 E 214	C A 8.5	٠ >	•	9 7038	8 5.7	30.04	19 4							0.06	87.5	A5.9	84.8	
185 SE 214M	F H 8.5	z	ec	8 4434	4 73	30+23	3 60			87.0	87.0	87.0	85.5	85.0	84.5	A4.0	83.5	A3.0
279 7 E 214M	F M 8.5	z	÷	8 5200	0 A3	30.09	19 6				85.0	86.5	88.0	89.1	90.0	90.0	88.4	85.5
422 41 E 214M	C M 8.5	• >	•	8 9383	3 74	. 29.80	95 0					89.5	88.8	87.5	85.4			
397 47 E 220	C A 8.5	• >	• sc	6 18930	0 70	29.63	3 50		81.0	84.0	86.0	87.0	86.5	82.0				
4H 4 E F70M	F M 8.5	* *	•	8 6880	92 0	. 29.00	0 5A	88.0	8H.0	84.0	R7.5	87.0	86.5	86.5	86.0	85.5	85.0	84.5
414 41 E F70M	C H B.5	• >	•	6 5907	7 71	30-10	74 0					91.8	95.6	93.0	4.56	90.0		
180 5 E F29M	F M A.3	>	•10 •10	0 6390	57 0	30.10	92 0			85.0	85.0	85.0	85.0	85.0	83.5	A2.5	82.0	H2.0
379 47 E F28M	C M N.3	• >	я +10	0 12103	3 70	79.66	6 50			91.0	91.0	91.0	91.0	91.0	0.06	A9.0	9A.0	A6.0
290 7 F 215M	F H B.5	2	ب •	5 4812	5 57	30.24	4 3A			A2.0	A9.0	90.1	88.9	86.8	85.0	A3.A	87.6	A2.0
415 41 F F20M	C M A.1	v +10	10 •10	1644 0	4 A0	16.66	1 64					85.4	86.8	R8.3	89.0	A9.0		
HEIE (14 104	C M 7.9	٠ ٢	~	0 6500	0 10	29.82	5.50			89.0	89.0	HG.0	98.0	87.5	A7.0	A7.0	84.5	94.0
M216 [14 F14	C M R.9	>	0	9265 0		6A 10.00	9 44					84.0	A5.8	84.0	0.00	0.00	87.0	85.0

TABLE F-I (Continued)

ب	ب	r r r	L L R2.0	1. L H7.0 78.0 85.0	ار ۱۳۶۰۵ ۱۳۶۰۵ ۱۳۶۰۵ ۱۳۶۰۵	L L A2.0 78.0 85.6 80.0 83.5	L R7.0 R2.0 R5.6 R0.0 R3.5	L L A7.0 R2.0 R5.6 R9.6 R9.5	L BP.0 78.0 82.0 83.6 83.5 83.5	L L A7.0 R2.0 R3.6 R3.5 R3.5 R4.0	L B2.0 R2.0 R3.5 R3.5 R9.0 R4.0	1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1	L H2.0 R2.0 R3.5 R3.5 R9.0 R4.0
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۔	82.5	82.5 79.0 86.0 84.5	82.5 79.0 86.0 84.5 82.0	82.5 84.5 84.5 90.5	82.5 86.0 84.5 82.0 84.5	82.5 86.0 84.5 90.5 80.5	82.5 84.5 82.0 84.5 90.5	82.5 86.0 84.5 90.5 80.5	82.5 84.5 84.5 80.5 80.5	82.5 86.0 84.5 82.0 84.5 90.5 86.0	82.5 79.0 86.0 84.5 84.5 84.5 84.0 86.0	82.5 86.0 84.5 90.5 80.5 81.0	82.5 84.5 84.5 84.5 80.5 81.0
ۇ ب د	90.0	80.0 80.0 86.0	80.0 80.0 86.0 82.5	82.5 90.0 82.5 90.8	80.0 80.0 82.5 85.0 90.8	80.0 80.0 82.5 90.8 90.8	80.0 80.0 82.5 90.8 85.0	80.0 87.0 85.0 85.0 85.0	80.0 80.0 85.0 85.0 85.0	80.0 87.0 85.0 85.0 85.0	80.0 85.0 85.0 85.0	80.0 85.0 85.0 85.0 85.0	80.0 82.5 85.0 85.0 85.0
ب	R0.0	80.0 80.0 85.0	85.0 85.0 85.0	80.0 85.0 85.0 83.0	80.0 85.0 85.0 85.5 85.5	80.0 85.0 85.0 85.0 85.0	80.0 85.0 85.0 85.0	80.0 83.0 85.0 85.0 85.0	80.0 85.0 85.0 85.0 85.0	80.0 83.0 85.0 85.0 85.0	80.0 85.0 85.0 85.0 85.0	85.0 85.0 85.0 85.0 85.0	80.0 85.0 85.5 85.0 85.0
ب		80.0 83.5	80.0 83.5 80.0 86.0	80.0 83.5 80.0 86.0	80.0 83.5 80.0 87.1	80.0 80.0 86.0 87.1	80.0 80.0 86.0 87.1	80.0 83.5 86.0 87.1	80.0 80.0 87.1 85.0	80.0 80.0 86.0 85.0	80.0 80.0 85.0 85.0	80.0 80.0 87.1 85.0	80.0 80.0 87.1 85.0
ب		79.0 82.5	79.0 A2.5 L L	79.0 A2.5 L L 87.5	79.0 A2.5 L L 87.5 84.8	79.0 A2.5 L L 87.5 84.8	79.0 A2.5 L L 87.5 84.8	79.0 A7.5 87.5 84.8	79.0 R2.5 L L 84.8 84.8	79.0 R7.5 87.5 84.8	79.0 R2.5 L L 84.8 84.8	79.0 R7.5 84.8 84.5	79.0 R7.5 84.8 84.5
ر		76.0											
68			•	•	•	•	•			•	•	•	•
64 29.20 62 29.08 70 30.18 94 29.96		70 29.55 70 29.72 68 30.40	29.55 29.72 30.40 29.21 29.85	29.55 29.72 30.40 29.21 29.85	70 29.55 70 29.72 64 30.40 74 29.85 65 30.09	70 29.55 70 29.72 68 30.40 70 29.21 74 29.85 70 29.28 70 29.28	29.55 30.40 29.21 29.85 30.09 29.28 30.01				29.72 50 30.40 66 29.21 50 29.21 50 29.62 50 29.28 50 30.01 32 29.63 49 30.00 135	29.55 30.60 30.62 29.85 30.01 29.85 29.85 30.01 30.00 30.00	70 29.55 68 30.40 70 29.21 74 29.85 65 30.09 70 29.85 70 30.01 70 29.85 70 30.00 71 29.85 70 30.00 71 70.00 87 30.00
										—	-	~	≈
6466 6467		6420 5937 6655	6420 5937 6655 14519 5595	6420 5937 6655 14519 5595	6420 5937 6655 14519 5595 10473	6420 5937 6655 14519 5595 10473 8161 6460	2 C 2 S C C C C C C C C C C C C C C C C	6 6 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8	64937 6655 14519 5595 10473 8161 6760 6764 12102 15069	64420 5937 6655 14519 5595 10473 8161 6764 12102 15069 10826			
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71. U # MATE U OE MATE U 65		7 e e				1 1 2 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1							
54 37 151 24 35 78						378 47 392 47 418 41 23 72 178 5 789 7 382 47 3 72 47							

TABLE F-I (Continued

		⊢α ∢ ; ω Σ :	ADVAN		!		PRIMAF	PRIMAHY R.F.	OCTANE		NUMBER	REQUIREMENTS,	EMENTS	5. AT	K M	
22 F A B A G V V B G B B G B G B G B G B G B G B G	CODE	z v ı	R RCU T	10.1		1000		1		2000	2250	•	2750	3000	2550	3500
722 F A B B B B B B B B B B B B B B B B B B	222	€	• cc •	5462						B3.0	84.5	84.0	H3.5	83.5		83.5
72. C A ALA, Y C A BLA,	225	•	• ©	5897								A7.0	91.0	A9.0		
224 C A ALA Y S ALA S S ALA R	222	⋖	• 60 •	7361						0.26	90.5	89.5	89.0	A8.0		86.0
722H F H 8.4 Y + 10 10 61.3 71 94.5 86.0 65.0 75.0 67.0 <t< td=""><td>256</td><td>⋖</td><td>* 50 *</td><td>5251</td><td></td><td></td><td></td><td></td><td></td><td>87.0</td><td>87.0</td><td>86.0</td><td>84.5</td><td>83.0</td><td>82.5</td><td>82.0</td></t<>	256	⋖	* 50 *	5251						87.0	87.0	86.0	84.5	83.0	82.5	82.0
222H F H B-L Y + 10 + 10 6703 7.0 670 91.0	M2CC	Σ	• •	6143		82.0		A6.0	96.0	85.5	85.0	84.5	84.0	A3.5	83.0	R2.5
FASH C M 8.45 Y · B · B · G576 60 PH - B · B · G576 60 PH - B · B · G576 60 PH - G · B · B · G576 PH - G · B · G · G · G · G · G · G · G · G ·	MSSC	I	+10 +1	6703								88.0	0.06	89.5	8A.0	97.0
FAM F M R.5 Y - 12 + 12 91-0	M544	I	* **	9259							4.06	8.06	90.2	86.0		
F43 C A 8.0 Y • 7 + 5 6079 To 30.11 SS To 30.11 SS To 30.11 SS To 30.11 SS To 30.11 SS To 30.11 SS To 30.11 SS To 30.11 SS To 30.11 SS To 30.11 SS To 30.11 SS To 30.11 SS To 30.11 SS To 30.11 SS To 30.11 SS To 30.11 SS To 30.11 SS To 30.11 SS To 30.12 SS To 30.11 SS To 30.12 SS To 30.11 SS To 30.12 SS To 30.11 SS SS To 30.11 SS SS To 30.11 SS SS To 30.11 SS SS To 30.11 SS To 30.11 SS To 30.11 SS To 30.11 SS To 30.11 SS To 30.11 SS To 30.11 SS To 30.11 SS To 30.11 SS To 30.11 SS To 30.11 SS To 30.11 SS To 30.11 SS To 30.11 <	FZ6M	Œ E	112 +1	9119		91.0		83.0	A3.0	85.5	82.5	82.5	82.0	82.0	A2.0	82.0
1144 C M 9.3 Y + M + M 11593 60 29.8M 56 A 2.0 A 2.0 B 3.0	F45	⋖	• 1 •	6109					97.0	91.0	91.5					
14M C M 8.6 N . 12 . 12 20.11 68 30.10 54 R . 1 R . 2 83.0 89.0 89.0 87.0 80.0 89.0 87.0 80.0 89.0 87.0 80.0 89.0 87.0 80.0 89.0 80.0 99	FZIM	D I	£	11593							90.5	87.0	83.5			
1444 F H 8.6 N · 5 · 5 4676 56 56 83.5 56 93.6 56 93.6 56 93.6 56 93.6 57.0 93.6 57.0 93.6 57.0 93.6 79.0 79.		Σ	+12 +1	20411						83.0	89.0	89.0	R7.8	A6.0		
120M C M 8.6 g M.6 g	УЗТ	£	• •	9866							82.0	80.5	19.0	74.0		
20M C M 8.6 6 Y + 5 + 6 9201 70 99.56 50 82.0 83.5 88.0 88.0 87.5 86.0 87.5 86.0 87.0 87.0 83.0 20M C M 8.6 Y + 5 + 6 + 10041 57 29.86 54 A.2 84.5 86.2 90.0 90.1 84.0 83.0 20M C M 8.6 Y + 5 + 5 + 12490 70 29.43 50 82.0 84.5 84.5 87.0<		Œ	+ 5 +	4676			A3.0	87.2	88.0	87.0	86.2	88.3	84.2	A3.0	A2.0	
20 M C M 8.6 f Y + 6 + 6 10041 57 29.86 54 82.5 84.2 f 90.0 f 90.1 84.0 f 82.0 f 82.5 84.5 f 82.5 84.5 f 82.6 f 82.0 f		Œ	+ 5	9201		82.0		88.0	88.0	BA.0	87.5	86.0	85.0	84.0	83.0	A2.0
20 M C M 8.6 Y · S · S · S · S · S · S · S · S · S ·		Œ	• 9 •	10041	67 29.86				85.5	88.2	0.06	90.1	AR.0	84.0		
120M F M 8.5 N · 5 · 5 12490 70 · 29.45 50 R4.5 84.5 81.0 82.5 82.0 81.0 82.5 82.0 82.0 82.0 82.0 82.0 82.0 82.0 82.0 82.0 82.0 82.0 82.0 82.5 82.0 82.5 82.0 8		I	• 5	1040							84.4	86.0	AA.0	0.06	86.0	
220M C M 8-5 T 1 1 12 9945 70 29.54 50 82.0 83.5 84.5 88.0 87.5 86.0 84.0 87.5 87.5 222M F M 8-4 N - 8 - 4 11714 64 30.0 64 85.0 90.7 91.0 90.7 91.0 90.7 85.6 115M F M 8-0 N - 0 0 36 40.79.20 66 77.0 18.5 78.0 77.0 18.5 78.0 77.0 18.5 78.0 77.0 77.0 87.0 77.0 77.0 87.0 77.0	T 120M	E.	• 5	12490			84.5	84.0	83.5	83.0	85.5	92.0	81.0	79.5	77.5	76.0
272M F M 8.4 N · A · B · B 178Z 71 29.98 51 85.0 86.3 84.6 90.1 90.1 89.5 222M C M 8.4 N · B · H 11714 64 64 85.0 90.7 91.0 90.7 85.0 115M F M 8.0 N · 0 36 40.79.20 66 77.0 77.0 78.5 77.0 78.0 1 23B F A 8.0 Y · 15 · 15 · 15 1716 56 29.06 72 77.0 87.5 77.0 87.5		Σ		9945		82.0		84.5	AA.0	88.0	87.5	86.0	84.0	A3.0	82.5	H2.0
722M C M R.4 N · 8 · H 11714 6R 30.06 64 85.0 90.7 91.0 90.7 91.0 90.7 91.6 90.7 91.0 90.7 91.6 91.6 91.6 91.6 91.6 91.6 91.6 91.6		Σ. C.	÷	1282					85.0	86.8	88.3	84.6	90.1	90.1	A9.5	AA. 7
115M F M B.O N O U 36 40 29.20 66 1 238 F A B.O Y 15 15 17 16 56 29.06 72		Œ	* &C *	11714						85.0	40.1	91.0	40.1	A5.0		
4 238 F A 8.0 Y +15 +15 1716 56 29.06 72		Σ	0	36						77.0	78.5	78.0				
	•	₹	+15	1716						A7.0	87.5					

TABLE F-I (Continued)

	- a:	SPARK														
OBS LAB VFHICLE	∢ Z S U	E A A I I A A A A A A A A A A A A A A A	7000	AMA			PHIMAR	Y R.F.	OCTA	NE NU	MBER	REGUIE	PRIMARY R.F. OCTANE NUMBER REGUIREMENTS. AT HPM	. AT	MdH	
NO NO CODE T S	T S C.R.	C.R. R RCU TST		MILES TMP BARD	HUM .	1000	1250	1500	1750	2000	2250	2500	1000 1250 1500 1750 2000 2250 2500 2750 3000 3250 3500	3000	3250	3500
802 30 11F 243	F A 7.5	F A 7.5 Y +21 +20	1862	80 29.25	26 !				85.5 87.5	87.5						
803 30 11F 243	F A 7.5	F A 7.5 Y +18 +18	2885	62 29.04	27				89.0	86.0						
A04 30 IA 238	F A 8.0	F A 8.0 Y +15 +15	732	55 29.40	7.2				86.5	87.5	88.5					
805 30 KL 217	F A 8.2	F A 8.2 Y +12 +12	3546	43 29.5A	52					82.0	84.5		85.5 85.5 85.5 85.5	85.5	ጸና	93.0
804 30 LCS 225	F A 8.2	F A 8.2 Y +11 +11	2539	47 29.40	22									86.0	A7.5	96
807 30 LJA 238	F A 8.0	7 •14 •14	2488	49 29.09	63			5.06	90.5 91.5 90.5	90.5	86.0			•	•	•
808 10 NIK 238	F A 8.6	F A 8.6 Y +10 +10	3034	59 29.37	8				85.0 83.5	83.5	80.0					
AFC NN OF COR	F A 8.6	F A 8.6 Y +10 +10	3891	60 29.23	ęę				87.0	84.5	86.0					
810 30 E F20M	F M 8.5	Y + 8 + 8	2335	56 29.47	82		88.5	91.5	91.5	91.5	90.5	89.5	A8.5 91.5 91.5 91.5 90.5 89.5 AB.5 A7.5 R5.5	A7.5	85.5	
R11 30 YUT 21HM	F M 8.5	F M 8.5 Y + 6 + 6	3103	60 29.23	82				87.5	88.5	89.5	0.00	87.5 88.5 89.5 90.0 90.5 0.05 2.08	2,00	7	

TABLE F-II

SPEED RANGE STATISTICAL DATA

1980 SELECT MODELS - 50% SATISFACTION

						Ξ	Engine R	RPM				
		1000	1250	1500	1750	2000	2250	2500	2750	3000	3250	3500
NC5 225/HC5 225/	50% Sat.	1	1	•	85.5	85.7	86.1	86.7	86.1	χ α	85.4	0 78
102 525/103 525	os :	ı	•		4.6	3.4	3.7	3.7	3.5	4.5		3.0
	Z	•	ı	ı	7	Ξ	14	17	15	15	14	14
NC7 228/HC7 228/	50% Sat	•	ſ			0	,	0	(!	!	
IC7 228/LC7 228	S. C.) (•	1	83.U	82.1	83.3	82.5	81.7	81.0	79.5
	2	ì		ı	ı	4.6	3.5	3.2	3.2	2.3	2.2	1.7
	=	ı	ı	1	•	2	15	91	17	12	10	6
NIJ 244	50% Sat.	•	ı		89.4	89.4	88.1	86.6	25.5	נ עמ	į	
	S	•	•	1	1.6	0.7	0.7	9.0	? -	· ~) i	
	z	1	ı	ı	7	∞	8	^	7	. 4	,	1 1
OCA 242/MCA 242	50% Sat.	ı	•	88.8	90.5	89.7	28	88	26 7	α π		
	8	ı	ı	1.3	1.2	2.0	2.4	2		. c	, ,	
	Z	1	1	9	12	13	10	8	9	4	ı	
0 V250/M V250	50% Sat.	ı		86.9	88.5	88.3	7 98	87.0	0 98	2 7 2	03	
	SD	1	ì	2.5	2.7	3.8	3.8		3 6		, c	
	z		ı	7	=	12	6	6	6	7:	4.	1 1
PC 137/KC 137/	50% Sat.	ı	89.7	89.7	88.8	88.4	87.1	86.1	7 28	83.0	83.8	0 [8
DC 13/	S :	•	3.1	3.9	5.8	3.6	3.2	2.9	3.0	3.5	, c.	
	Ż	ı	വ	01	10	=	10	10	8	æ	7	7

FIGURE F.1

1980 Select Models:

NC5 225 HC5 225 IC5 225 LC5 225

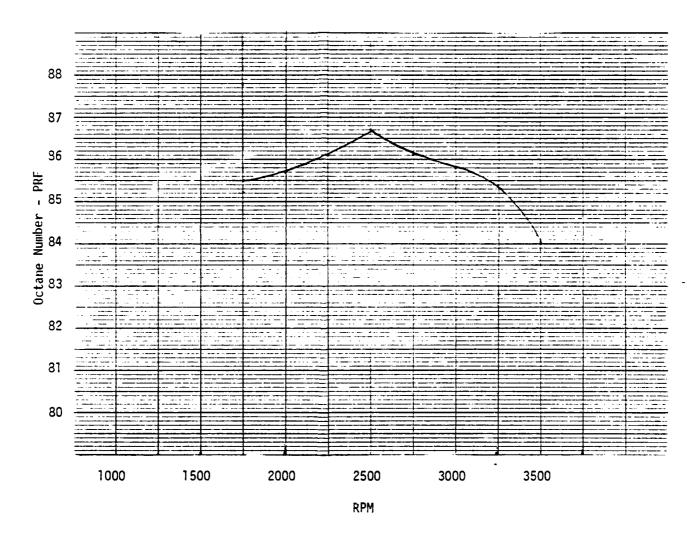


FIGURE F.2

1980 Select Models:

NC7 228 HC7 228 IC7 228 LC7 228

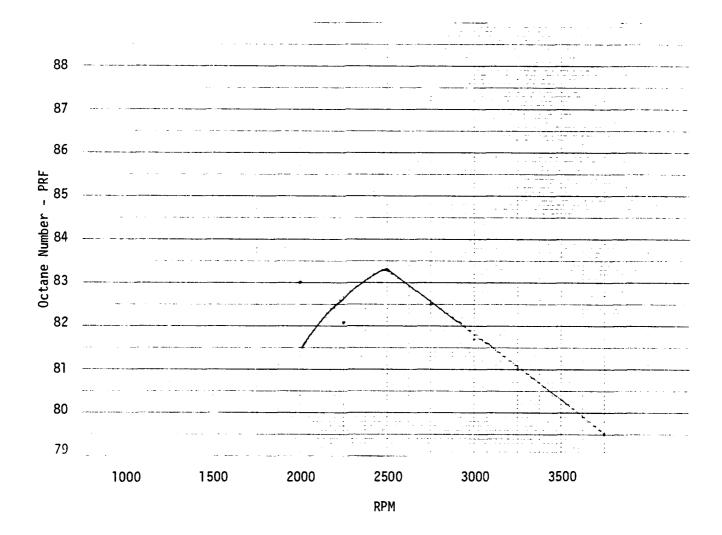


FIGURE F.3

1980 Select Models: OCA 242 MCA 242

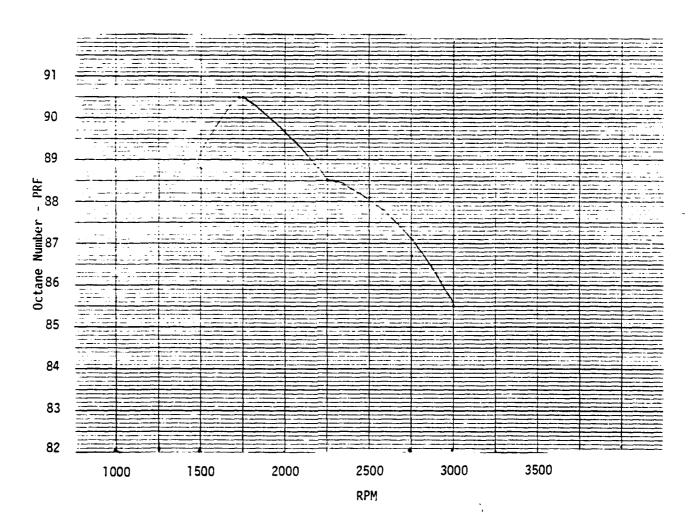


FIGURE F.4

1980 Select Model: NIJ 244

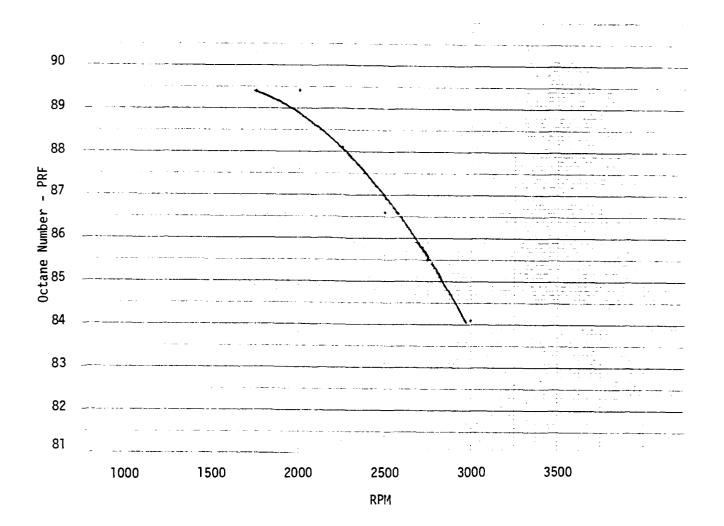


FIGURE F.5

1980 Select Models: 0 V250 M V250

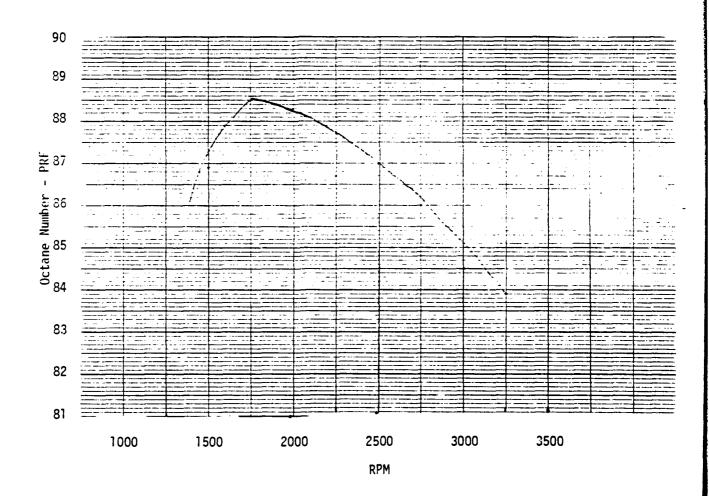
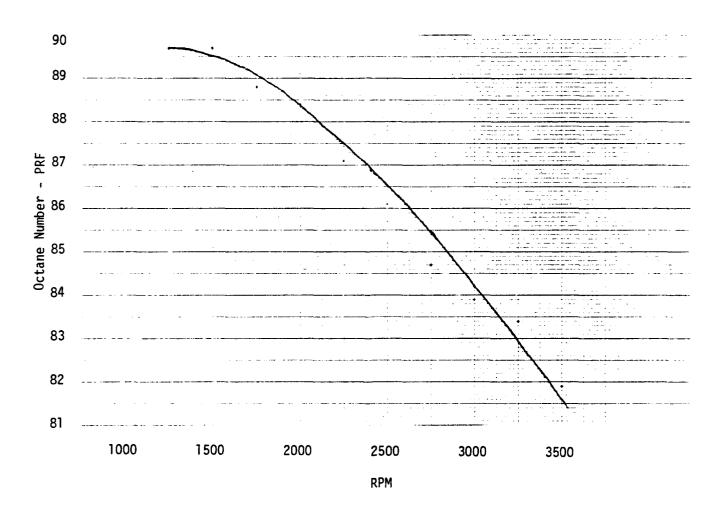


FIGURE F.6

1980 Select Models: PC 137 KC 137 DC 137



APPENDIX G

CONFIDENCE LIMITS OF
OCTANE NUMBER REQUIREMENT DISTRIBUTIONS

CONFIDENCE LIMITS OF OCTANE NUMBER REQUIREMENT DISTRIBUTIONS

Octane number requirements of vehicles presented in this survey are determined at the levels that satisfy certain percentages of specific vehicle populations. In many cases, the recorded octane number requirement is followed by a plus and minus limit, referred to as the confidence interval. These limits give the interval within which the requirement for that satisfaction level would be expected 95% of the time in replicate testing.

At the 50% satisfaction level, the 95% confidence interval is calculated as follows:

$$CI = \pm ts / \sqrt{n}$$

where t = Students t at the proper number of degrees of freedom*

- s = Standard deviation, calculated directly from the data or estimated
 as the difference between the 84.16th and 50th percentiles (assuming normal distribution)
- n = Number of vehicles in population.

At other satisfaction levels:

CI =
$$\pm ts \sqrt{1/n + k^2/[2(n-1)]}$$

At the 90% satisfaction level, k = 1.2817. For other satisfaction levels, appropriate values for k may be found in the standard statistical tables.

* Distribution of t for probability = 0.05.

	Degrees of Freedom**	t.	Degrees of Freedom	t
		12.706 4.393 3.182 2.776 2.571 2.447 2.365 2.306 2.262 2.228 2.201 2.179 2.160 2.145 2.131 2.120	of Freedom 18 19 20 21 22 23 24 25 26 27 28 29 30 40 60 120	t 2.101 2.093 1.086 2.080 2.074 2.069 2.064 2.056 2.052 2.048 2.045 2.042 2.042 2.021 2.000 1.980
** D.F = (n-1)	17	2.110	•	1.960

TABLE G-I

95% CONFIDENCE LIMITS FOR MAXIMUM REQUIREMENTS

1980 Weighted Vehicle Population Groups

					_	95%	Confiden	ce Limi	ts
				Std. (S		R0	N	MO	N
	Fuel	<u>n</u>	<u>t</u> _	RON	MON	50%_	90%_	50%	90%
U.S. and Imported Vehicles	PR FBRU FBRSU	429 429 429	1.96 1.96 1.96	2.64 3.39 3.89	2.64 2.13 2.24	0.25 0.32 0.37	0.34 0.43 0.50	0.25 0.20 0.21	0.34 0.27 0.29
U.S. and Imported Cars	PR FBRU FBRSU	407 407 407	1.96 1.96 1.96	2.59 3.57 4.10	2.59 2.24 2.35	0.25 0.35 0.40	0.34 0.47 0.54	0.25 0.22 0.23	0.34 0.29 0.31
U.S. Vehicles	PR FBRU FBRSU	344 344 344	1.96 1.96 1.96	2.50 3.24 3.70	2.50 2.05 2.15	0.26 0.34 0.39	0.36 0.46 0.53	0.26 0.22 0.23	0.36 0.29 0.31
U.S. Cars	PR FBRU FBRSU	326 326 326	1.96 1.96 1.96	2.54 3.42 3.82	2.54 2.14 2.20	0.28 0.37 0.41	0.37 0.50 0.56	0.28 0.23 0.24	0.37 0.31 0.32
Imported Vehicles	PR FBRU FBRSU	85 85 85	1.99 1.99 1.99	2.83 3.01 3.33	2.83 1.90 1.97	0.61 0.65 0.72	0.83 0.88 0.97	0.61 0.41 0.42	0.83 0.56 0.57

TABLE G-II

95% CONFIDENCE LIMITS FOR FBRU PART-THROTTLE REQUIREMENTS

1980 Weighted Vehicle Population Groups

			CAL D.		5% Confi	dence Lim	its
			Std . De (S)		RON	M	ON
	<u>n</u>	_t	RON M	ON 50%	90%	50%	90%
U.S. and Imported Vehicles	389	1.96	5.36 3	.41 0.53	0.72	0.34	0.46
U.S. and Imported Cars	375	1.96	5.04 3	.21 0.51	0.69	0.33	0.44
U.S. Vehicles	312	1.96	5.82 3	.69 0.65	0.87	0.41	0.55
U.S. Cars	296	1.96	5.36 3	.41 0.61	0.82	0.39	0.52
Imported Vehicles	77	1.99	5.02 3	.23 1.14	1.54	0.73	0.99

TABLE G-III

95% CONFIDENCE LIMITS FOR MAXIMUM REQUIREMENTS

1980 Select Models

						95	% Confid	95% Confidence Limits	ts
				Std. Dev. (S)	Dev.	8	RON	W	MOM
Car Model	Fuel	=	44	RON	MOM	20%	%06	20%	%06
NCS 225/HCS 225/ ICS 225/LCS 225	PR FBRU FBRSU	24 24 24	2.069 2.069 2.069	2.868 3.747 3.799	2.868 2.430 2.297	1.21 1.58 1.60	1.65 2.16 2.19	1.21 1.03 0.97	1.65 1.40 1.32
NC7 228/HC7 228/ IC7 228/LC7 228	PR FBRU FBRSU	22 22	2.086 2.086 2.086	2.906 3.333 3.447	2.906 2.268 2.100	1.32	1.81 2.07 2.14	1.32 1.03 0.96	1.81
NIJ 244	PR FBRU FBRSU	12 12 12	2.201 2.201 2.201	0.985 1.564 1.658	0.985 0.961 0.965	0.63 0.99 1.05	0.86 1.37 1.45	0.63 0.61 0.61	0.86 0.84 0.84
OCA 242/MCA 242	PR FBRU FBRSU	14 14	2.160 2.160 2.160	1.393 1.562 2.341	1.393 0.978 1.443	0.80 0.90 1.35	1.10 1.24 1.86	0.80 0.56 0.83	1.10 0.78 1.14
0 V250/M V250	PR FBRU FBRSU	14 14	2.160 2.160 2.160	1.737 2.400 2.112	1.737 1.505 1.213	1.00	1.38 1.90 1.67	1.00 0.87 0.70	1.38 1.19 0.96
PC 137/KC 137/DC 137	PR FBRU FBRSU	15 15	2.145 2.145 2.145	2.770 3.474 3.326	2.770 2.282 2.101	1.53 1.92 1.84	2.10 2.64 2.53	1.53 1.26 1.16	2.10 1.73 1.60

APPENDIX H

MAXIMUM OCTANE NUMBER REQUIREMENTS OF SELECT MODELS

TABLE H-I

MAXIMUM OCTANE NUMBER REQUIREMENTS - 1980 SELECT MODELS

	Mode]:	- 1	NC5 225/HC5 225/IC5 225/LC5 225	/105 225/	1C5 225	Model:		NC7 228/HC7 228/1C7 228/LC7 228	/107 228/	/LC7 228
Dorogat	por		FBRU	FBRSU	SU		H	FBRU	FB.	FBRSU
Satisfied	O.N.	RON	MOM	RON	MON	PRF 0.N.	RON	MON	RON	MON
S	83.9	84.9	9.62	87.4	79.1	79.8	80.7	76.7	81.5	75.5
10	85.0	86.3	80.5	88.8	79.9	80.9	81.9	77.5	82.7	76.3
50	86.2	88.0	81.6	90.5	80.9	82.2	83.4	78.5	84.3	77.2
30	87.1	89.1	82.4	91.7	81.6	83.1	84.4	79.2	85.4	77.9
40	87.9	90.2	83.0	92.7	82.3	83.9	85.3	79.8	86.3	78.4
20	88.6	91.1	83.6	93.7	82.8	84.6	86.2	80.4	87.2	79.0
09	89.4	92.1	84.2	94.6	83.4	85.4	87.0	81.0	88.0	79.5
70	90.1	93.1	84.9	95.7	84.0	86.1	87.9	81.6	89.0	80.1
80	91.1	94.3	85.7	6.96	84.8	87.1	89.0	82.3	90.1	80.7
06	92.3	95.9	86.7	98.6	85.8	88.3	90.5	83.3	91.6	81.7
95	93.4	97.3	87.6	6.99	9.98	89.4	7.16	84.1	95.8	82.4

(Continued)

TABLE H-I (Continued)

MAXIMUM OCTANE NUMBER REQUIREMENTS - 1980 SELECT MODELS

		Mode	Model: NIJ 244	44		2	Model: 0	OCA 242/MCA 242	4 242	
4	Ĺ	FBRU	₽	FBRSU	ns ns	i	EB	FBRU	FBRSU	n:
Satisfied	. N.	RON	MON	RON	MON	0.N.	RON	MOM	RON	MON
2	88.7	89.5	82.7	90.0	9.08	88.7	89.3	82.5	89.3	80.1
10	89.1	90.1	83.0	9.06	81.0	89.2	89.9	82.9	90.1	80.7
20	89.5	8.06	83.4	91.4	81.4	89.8	90.5	83.3	91.2	81.3
30	89.8	91.3	83.8	91.9	81.7	90.2	91.0	83.6	91.9	81.8
40	90.1	91.7	84.0	92.3	82.0	9.06	91.5	83.9	95.6	82.1
20	90.3	92.1	84.3	92.8	82.2	91.0	91.9	84.1	93.1	82.5
09	90.6	92.5	84.5	93.2	82.5	91.3	92.3	84.4	93.7	82.9
70	8.06	92.9	84.8	93.6	82.7	91.7	92.7	84.6	94.4	83.3
80	91.2	93.4	85.1	94.1	83.0	92.1	93.2	84.9	95.1	83.7
06	91.6	94.1	85.5	94.9	83.5	92.7	93.9	85.4	1.96	84.4
95	92.0	94.7	82.8	95.5	83.8	93.3	94.4	85.7	97.0	84.9

TABLE H-I (Continued)

MAXIMUM OCTANE NUMBER REQUIREMENTS - 1980 SELECT MODELS

		Model:	Model: 0 V250/M V250	V250		Mc	ode1: PC	Model: PC 137/KC 137/DC 137	137/00 13	7
4	i d	FBRU	RU	FBRSU	SU	L 2	B	FBRU	FBRSU	SU
Satisfied	N.	RON	MOM	RON	MON	0.N	RON	MON	RON	MON
2	88.5	88.3	81.9	89.5	80.4	87.6	88.1	81.6	86.8	80.4
10	89.1	89.2	82.5	90.3	80.8	88.6	89.3	82.4	91.0	81.1
50	6.68	90.3	83.1	91.2	81.4	89.9	8.06	83.4	92.5	82.1
30	90.4	91.0	83.6	91.9	81.7	90.7	91.9	84.2	93.6	82.7
40	90.9	91.7	84.0	92.5	82.1	91.5	92.9	84.8	94.5	83.3
20	91.4	92.3	84.4	93.0	82.4	92.2	93.8	85.4	95.3	83.8
09	91.8	92.9	84.8	93.5	82.7	92.9	94.6	85.9	96.1	84.4
70	92.3	93.5	85.2	94.1	83.0	93.7	92.6	86.5	97.0	84.9
80	92.8	94.3	85.7	94.8	83.4	94.5	7.96	87.3	98.1	85.6
06	93.6	95.4	86.3	95.7	83.9	95.8	98.2	88.3	9.66	86.5
95	94.2	96.2	86.9	96.5	84.4	8.96	99.5	89.1	100.8	87.3

MAXIMUM OCTANE NUMBER REQUIREMENTS OF INDIVIDUAL CARS OF

1980 SELECT MODEL NC5 225/HC5 225/IC5 225/LC5 225

	% Satisfied	2,08	6.25	10.42	14.58	18.75	22.92	27.08	31.25	35.42	39.58	43.75	47.92	52.08	56.25	60.42	64.58	68.75	72.92	77.08	81.25	85.42	89.58	93.75	97.92				(Continued)
	(R+M)/2	82.2	83.0	84.2	84.6	85.3	85.3	86.1	86.9	87.7	88.5	88.5	89.5	89.2	89.2	89.2	89.2	0.06	90.0	0.06	0.06	8.06	7.16	95.6	94.4		88.263	3.046	
FBRSU	MOM	78.4	79.0	79.8	80.1	90.08	90.6	81.2	81.8	82.4	83.0	83.0	83.5	83.5	83.5	83.5	83.5	84.1	84.1	84.1	84.1	84.7	85.4	86.3	87.9	24	82.838	2.297	
	RON	86.0	87.0	88.5	89.0	90.0	0.06	91.0	92.0	93.0	94.0	94.0	95.0	95.0	95.0	95.0	95.0	0.96	96.0	0.96	0.96	97.0	98.0	99.0	101.0		93,688	3.799	
	(R+M)/2	80.2	82.4	83.2	84.0	84.8	85.6	85.6	86.5	86.5	86.5	87.3	87.3	88.1	88.1	88.9	88.9	88.9	88.9	88.9	83.8	8.68	9.06	93.0	93.0		87.367	3.088	
FBRU	MOM	77.8	79.7	80.4	81.0	81.7	82.3	82.3	83.0	83.0	83.0	83.6	83.6	84.2	84.2	84.8	84.8	84.8	84.8	84.8	85.5	85.5	86.1	88.1	88.1	24	83.629	2.430	
	RON	82.5	85.0	86.0	87.0	88.0	89.0	89.0	90.0	90.0	90.0	91.0	91.0	92.0	92.0	93.0	93.0	93.0	93.0	93.0	94.0	94.0	95.0	98.0	98.0		91.104	3.747	
;	PRF O.N.	82.0	84.0	85.0	85.0	86.0	87.0	87.0	87.0	88.0	89.0	89.0	89.0	89.0	89.0	90.0	90.0	90.0	90.0	90.0	91.0	92.0	92.0	92.5	94.0	24	88.646	2.868	
	-	_	. 2	ო	4	വ	9	7	œ	6	10	=	12	13	14	15	16	17	18	19	20	21	22	23	24	z	50% (X)	v	

TABLE H-II (Continued)

MAXIMUM OCTANE NUMBER REQUIREMENTS OF INDIVIDUAL CARS OF

1980 SELECT MODEL NC7 228/HC7 228/IC7 228/LC7 228

5	Satisfied	2.38	7.14	11.90	16.67	21.43	26.19	30.95	35.71	40.48	45.24	20.00	54.76	59.52	64.29	69.05	73.81	78.57	83.33	88.10	98.86	97.02			
	(R+M)/2	9.77	78.8	80.5	80.5	81.4	81.4	82.2	82.2	82.2	82.2	83.0	83.0	83.0	83.8	83.8	83.8	85.3	86.1	86.9	87.3	89.2		83.069	2.772
FBRSU	MON	74.8	75.6	77.0	77.0	77.7	77.7	78.4	78.4	78.4	78.4	79.0	79.0	79.0	9.6/	9.6/	9.6/	90.8	81.2	81.8	82.1	83.5	21	78.971	2.100
	RON	81.0	82.0	84.0	84.0	85.0	85.0	86.0	86.0	86.0	86.0	87.0	87.0	87.0	88.0	88.0	88.0	90.0	91.0	92.0	92.5	95.0		87.167	3.447
	(R+M)/2	78.0	79.3	79.8	80.6	81.4	81.9	82.4	83.2	83.2	83.2	83.2	83.2	83.2	84.0	84.0	84.0	84.8	85.6	86.5	87.7	90.2		83.302	2.800
FBRU	MON	75.9	77.1	77.5	78.2	78.9	79.3	7.67	80.4	80.4	80.4	80.4	80.4	80.4	81.0	81.0	81.0	81.7	82.3	83.0	83.9	82.8	21	80.414	2.268
	RON	80.0	81.5	82.0	83.0	84.0	84.5	85.0	86.0	86.0	86.0	86.0	86.0	86.0	87.0	87.0	87.0	88.0	89.0	90.0	91.5	94.5		86.190	3.333
1 6	0.N	78.0	79.0	81.0	82.0	83.0	83.0	84.0	85.0	85.0	85.0	85.0	85.0	85.0	86.0	86.0	86.0	86.0	87.0	87.0	89.0	90.0	21	84.619	2.906
	***	_	2	ო	4	.c	9	7	œ	6	10	Ξ	12	13	14	15	16	17	18	19	2	21	z	50% (\overline{X})	v

MAXIMUM OCTANE NUMBER REQUIREMENTS OF INDIVIDUAL CARS OF

1980 SELECT MODEL NIJ 244

;	Satisfied	4.17	12,50	20.83	29,17	37.50	45,83	54.17	62.50	70.83	79.17	87.50	95.83			
	(R+M)/2	85.3	86.1	86.9	86.9	86.9	86.9	87.7	87.7	87.7	88.5	89.2	0.06		87.492	1.312
FBRSU	MON	80.6	81.2	81.8	81.8	81.8	81.8	82.4	82.4	82.4	83.0	83.5	84.1	12	82.233	0.965
	RON	90.0	91.0	92.0	92.0	92.0	92.0	93.0	93.0	93.0	94.0	95.0	0.96		92.750	1.658
	(R+M)/2	86.5	87.3	87.3	87.3	87.3	88.1	88.1	88.1	88.9	88.9	88.9	91.4		171.88	1.263
FBRU	MON	83.0	83.6	83.6	83.6	83.6	84.2	84.2	84.2	84.8	84.8	84.8	86.7	12	84.258	0.961
	RON	90.0	91.0	91.0	91.0	91.0	92.0	92.0	92.0	93.0	93.0	93.0	0.96		92.083	1.564
1 4	O.N.	89.0	89.0	89.0	90.0	90.0	90.0	91.0	91.0	91.0	91.0	91.0	92.0	12	90.333	0.985
	·-		2	က	4	2	9	7	&	6	10	=	12	z	50% (X)	v

TABLE H-II (Continued)

MAXIMUM OCTANE NUMBER REQUIREMENTS OF INDIVIDUAL CARS OF

1980 SELECT MODEL OCA 242/MCA 242

	1		FBRU			FBRSU		;
	PRF 0.N.	RON	MON	(R+M)/2	RON	MON	(R+M)/2	% Satisfied
_	88.0	88.0	81.7	84.8	89.0	80.1	84.6	3.57
2	89.0	90.0	83.0	86.5	90.0	90.6	85.3	10.71
က	90.0	91.0	83.6	87.3	91.5	81.5	86.5	17.86
4	90.0	91.0	83.6	87.3	93.0	82.4	87.7	25.00
J.	90.0	92.0	84.2	88.1	93.0	82.4	87.7	32.14
9	91.0	92.0	84.2	88.1	93.0	82.4	87.7	39.29
7	91.0	92.0	84.2	88.1	93.0	82.4	87.7	46.43
∞	91.5	92.0	84.2	88.1	93.0	82.4	87.7	53.57
6	92.0	92.0	84.2	88.1	93.0	82.4	87.7	60.71
10	92.0	92.0	84.2	88.1	93.0	82.4	87.7	67.86
=	92.0	93.0	84.8	88.9	94.0	83.0	88.5	75.00
12	92.0	93.0	84.8	88.9	94.0	83.0	88.5	82.14
13	92.0	94.0	85.5	83.8	95.5	83.8	89.6	89.29
14	93.0	94.0	85.5	8.68	0.66	86.3	95.6	96.43
z	14		14			14		
:						•		
50% (X)	90.964	91.857	84.121	87.989	93.143	82.507	87.825	
v	1.393	1.562	0.978	1.270	2.341	1.443	1.891	

MAXIMUM OCTANE NUMBER REQUIREMENTS OF INDIVIDUAL CARS OF

1980 SELECT MODEL 0 V250/M V250

	t d		FBRU			FBRSU		;
-	PRF 0.N.	RON	MON	(R+M)/2	RON	MON	(R+M)/2	% Satisfied
_	88.0	88.0	81.7	84.8	89.0	80.1	84.6	3.57
2	90.0	89.0	82.3	85.6	90.0	80.6	85.3	10.71
က	90.0	90.0	83.0	86.5	91.0	81.2	86.1	17.86
4	90.0	91.0	83.6	87.3	92.0	81.8	86.9	25.00
2	90.0	91.0	83.6	87.3	92.0	81.8	86.9	32.14
9	91.0	91.0	83.6	87.3	92.0	81.8	86.9	39.29
7	91.0	92.0	84.2	88.1	93.0	82.4	87.7	46.43
œ	91.0	93.0	84.8	88.9	93.0	82.4	87.7	53.57
6	92.0	93.0	84.8	88.9	94.0	83.0	88.5	60.71
10	92.0	94.0	85.5	89.8	95.0	83.5	89.2	98.79
=	93.0	94.0	85.5	89.8	95.0	83.5	89.5	75.00
12	93.0	95.0	86.1	90.6	95.0	83.5	89.2	82.14
13	94.0	95.0	86.1	9.06	95.0	83.5	89.2	89.29
14	94.0	0.96	86.7	91.4	0.96	84.1	0.06	96.43
z	14		14			14		
50% (X)	91.357	92.286	84.393	88.339	93.000	82.371	87.686	
s	1.737	2.400	1.505	1.952	2.112	1.213	1.663	

(Continued)

MAXIMUM OCTANE NUMBER REQUIREMENTS OF INDIVIDUAL CARS OF

137
137/DC
KC
137/
PC
MODEL PC

5	Satisfied	3.33	10.00	16.67	23.33	30.00	36.67	43.33	20.00	26.67	63.33	70.00	76.67	83.33	90.00	6.67			
	(R+M)/2	84.6	86.1	86.5	88.5	88.5	88.5	88.5	90.0	90.0	8.06	8.06	8.06	91.7	95.6	I		(89.560)	(2.711)
FBRSU	MON	80.1	81.2	81.5	83.0	83.0	83.0	83.0	84.1	84.1	84.7	84.7	84.7	85.4	86.3	Ŧ	15	(83.820)	(2.101)
	RON	89.0	91.0	91.5	94.0	94.0	94.0	94.0	0.96	0.96	97.0	97.0	97.0	98.0	0.66	x		(95.300)	(3.326)
	(R+M)/2	85.6	86.0	86.5	87.7	88.1	88.1	88.9	88.9	83.8	90.6	90.6	91.4	91.8	93.0	I		(89.560)	(2.877)
FBRU	MON	82.3	82.6	83.0	83.9	84.2	84.2	84.8	84.8	85.5	86.1	86.1	86.7	87.0	88.1	=	15	(85.353)	(2.282)
	RON	89.0	89.5	90.0	91.5	92.0	92.0	93.0	93.0	94.0	95.0	95.0	0.96	96.5	98.0	±		(93.767)	(3.474)
į	O.N.	88.0	88.0	89.0	90.5	91.0	91.0	92.0	92.0	93.0	93.0	93.5	94.0	94.5	95.5	98.0	15	92.200	2.770
		_	2	က	4	5	9	7	œ	6	10	=	12	13	14	15	z	50% (X)	v

APPENDIX I

PROCEDURES FOR PLOTTING

OCTANE NUMBER REQUIREMENT DISTRIBUTION DATA

WEIGHTED VEHICLE/CAR POPULATIONS

Weighting factors for each vehicle model were developed from information supplied by the U.S. Vehicle Manufacturers and from information published (Ward's Automotive Reports) for imported vehicles. These weight factors were proportioned to the relative production and/or sales volumes of the vehicles tested.

For any vehicle having octane requirements lower (L) than the lowest octane number fuel available within a given fuel series, a number 0.5 Research/0.4 Motor lower was assigned. Similarly, for any vehicle having octane requirements higher (H) than the highest octane fuel available within a given fuel series, a number 0.5 Research/0.4 Motor higher was assigned.

The weighting factors of each vehicle model were divided by the number of vehicles tested to calculate individual vehicle weight factors. The octane requirements for each vehicle were then arranged in increasing order with the appropriate individual weighting factors. The percent of vehicles at each octane requirement level represents the summation of all vehicle weighting factors before that level, plus one-half the sum of the weighting factors at that level. The individual vehicle weighting factors are adjusted so that the summation of all weighting factors is 100.00 for any vehicle population of interest. The midpoint percentiles are plotted versus octane number requirement on arithmetic probability paper and a distribution curve is drawn through the points. These distributions are then plotted point to point on Cartesian coordinates for figures shown in the survey report.

SELECT CAR MODELS

For individual car models, the octane number requirement distribution curves were plotted by the "Z" method as described in "Statistical Estimation of the Gasoline Octane Number Requirement of New Model Automobiles," C. S. Brinegar and R. R. Miller, <u>Technometrics</u>, Vol. 2, No. 1, February 1960.

The procedure is as follows:

For any cars having octane requirements lower (L) than the lowest octane number fuel available within a given fuel level, a number 0.5 Research/0.4 Motor lower was assigned. Similarly, for individual cars having octane requirements higher (H) than the highest octane fuel available within a given fuel series a number 0.5 Research/0.4 Motor higher was assigned.

Using all observed and estimated octane number values, calculate the mean (\overline{X}) and the standard deviation (S) from the data for each car model.

1.
$$\overline{\chi} = \frac{z \ \chi_{i}}{n}$$

$$s = \sqrt{\frac{1}{n-1} \left[z \ \chi_{i}^{2} - \left(\frac{z \ \chi_{i}}{n}\right)^{2}\right]}$$

Where $X_i = 0$ ctane number requirement of the ith car of a given model n = Number of cars of that model.

2. Estimate octane number requirements at the percentiles of interest from octane number requirement distribution data by

$$0.N. = \overline{X} + ks$$

where k is selected from normal distribution tables.

Values of k used to calculate percentiles in this report are:

<u>Percentile</u>	k
5	-1.645
10	-1.282
20	-0.842
30	-0.524
40	-0.253
50	0
60	+0.253
70	+0.524
80	+0.842
90	+1.282
95	+1.645

The requirements were arranged in increasing order and plotted on arithmetic probability paper; the percent satisfaction for any car is calculated by the following relationship:

Percent satisfied:
$$i^{th}$$
 car = $\frac{(i-0.5)}{N}$ 100

where N is the total number of cars tested for a given fuel and i is an integer having increasing values from 1 to N.

Curves may either be faired through the plotted points or a straight line superimposed using the mean and standard deviation calculated above. From inspection of these curves, revised L and H values may be indicated. If so, new means and standard deviations may be calculated.

A P P E N D I X J

GEAR POSITION FOR

MAXIMUM OCTANE NUMBER REQUIREMENTS

TABLE J-I

GEAR POSITION AT 1980 MAXIMUM OCTANE NUMBER REQUIREMENT

FBRU Fuel

	Automat Transmis		Manual Transmiss		All Vehic	cles
GEAR POSITION	No. <u>Vehicles</u>	<u>0/</u> /o	No. <u>Vehicles</u>	%	No. <u>Vehicles</u>	<u>0′</u> /2
Highest						
<pre>Full-Throttle Part-Throttle Full = Part-Throttle</pre>	183 12 23	55 4 7	57 11 14	59 11 15	240 23 37	56 5 8
Passing			٠		·	
Full-Throttle	99	30	8	8	107	25
Miscellaneous						
Highest PT = Passing FT Highest PT > Passing FT Max. Requirement <78 Max. Requirement >102	5 3 4 3	1 1 1	1 2 4 0	1 2 4 0	6 5 8 3	2 1 2 1
	332	100	97	100	 429	100

